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Shimizu et al.

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(45) **Date of Patent: Jan. 26, 2016**

(54) **VEHICLE APPROACH ALERT DEVICE FOR SADDLE-RIDDEN ELECTRIC VEHICLE**

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(73) Assignee: **HONDA MOTOR CO., LTD**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 338 days.

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PCT Pub. Date: **Sep. 7, 2012**

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Feb. 28, 2011 (JP) 2011-043324
Feb. 28, 2011 (JP) 2011-043325

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B60Q 1/00 (2006.01)
B60Q 5/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B60Q 5/008*** (2013.01); ***B60Q 1/0017*** (2013.01); ***B62J 3/00*** (2013.01); ***G10K 9/22*** (2013.01); ***G10K 11/004*** (2013.01); *B62K 2202/00* (2013.01); *B62K 2204/00* (2013.01)

(58) **Field of Classification Search**
CPC B60Q 1/0017; B60Q 5/008; B62J 3/00; G10K 11/004; G10K 9/22; B62K 2202/00; B62K 2204/00
See application file for complete search history.

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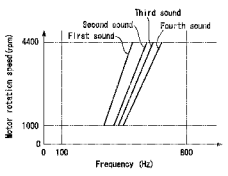
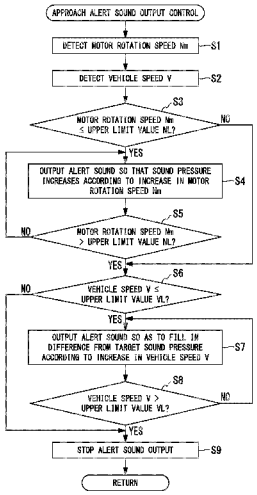
Primary Examiner — Quang D Pham
(74) *Attorney, Agent, or Firm* — Birc, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A vehicle approach alert device for a saddle-ridden electric vehicle is a vehicle approach alert device for a saddle-ridden electric vehicle that is provided with a sound emitter that is attached on the vehicle body of a saddle-ridden electric vehicle having an electric motor in a power engine, and that emits an alert sound to a surrounding area for notifying the surrounding area of approach of the saddle-ridden electric vehicle, such that sound emission of the sound emitter is controlled, and the sound emitter is arranged so that the direction of sound emission is oriented diagonally downward and forward of the saddle-ridden electric vehicle.

20 Claims, 14 Drawing Sheets





(51) **Int. Cl.**

B62J 3/00	(2006.01)
G10K 9/22	(2006.01)
G10K 11/00	(2006.01)

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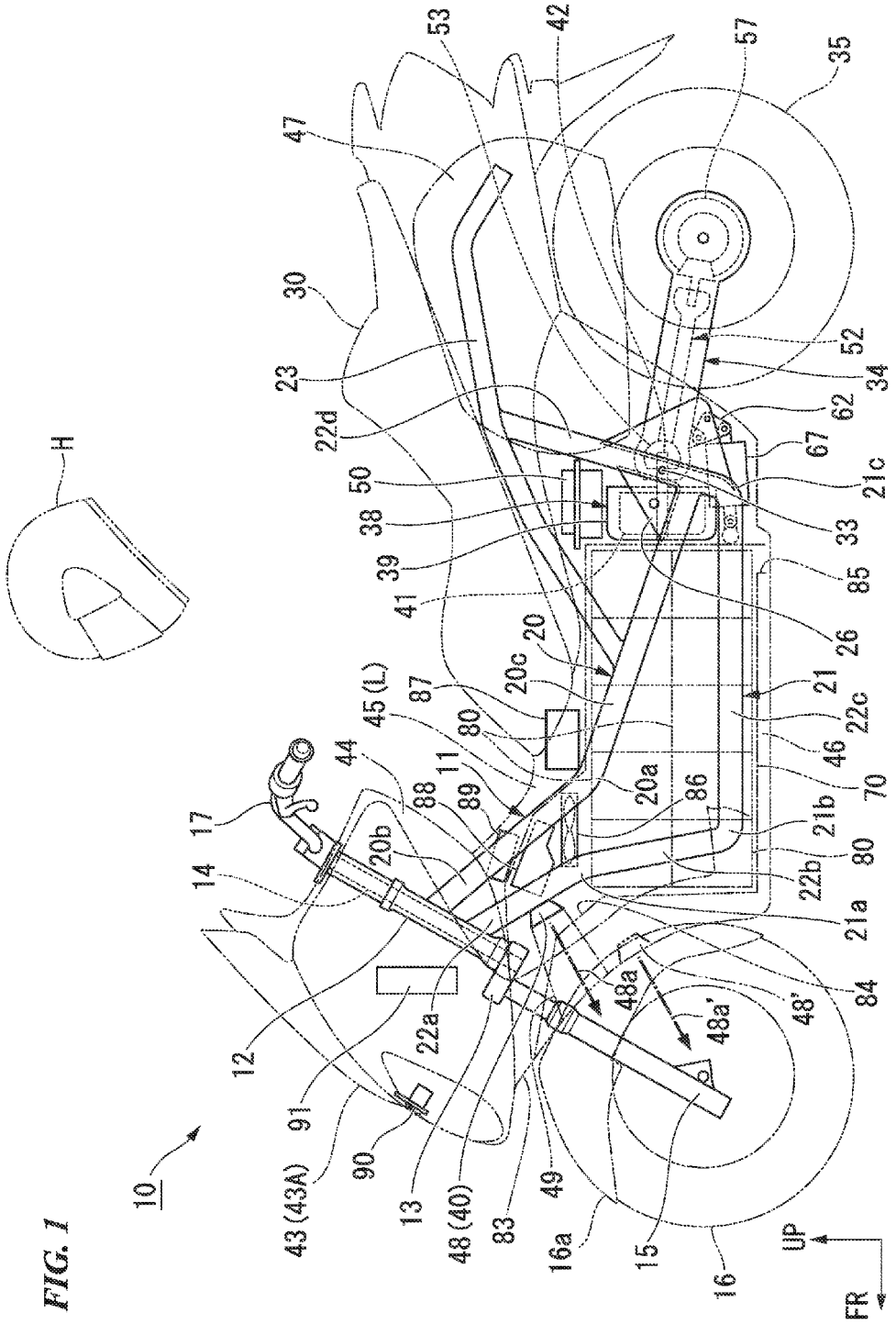
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20a
20b
20c
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21c
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22c
22d
23
26
30
33
34
35
38
39
40
41
42
43 (43A)
44
45 (L)
46
47
48
48a
48a'
48'
49
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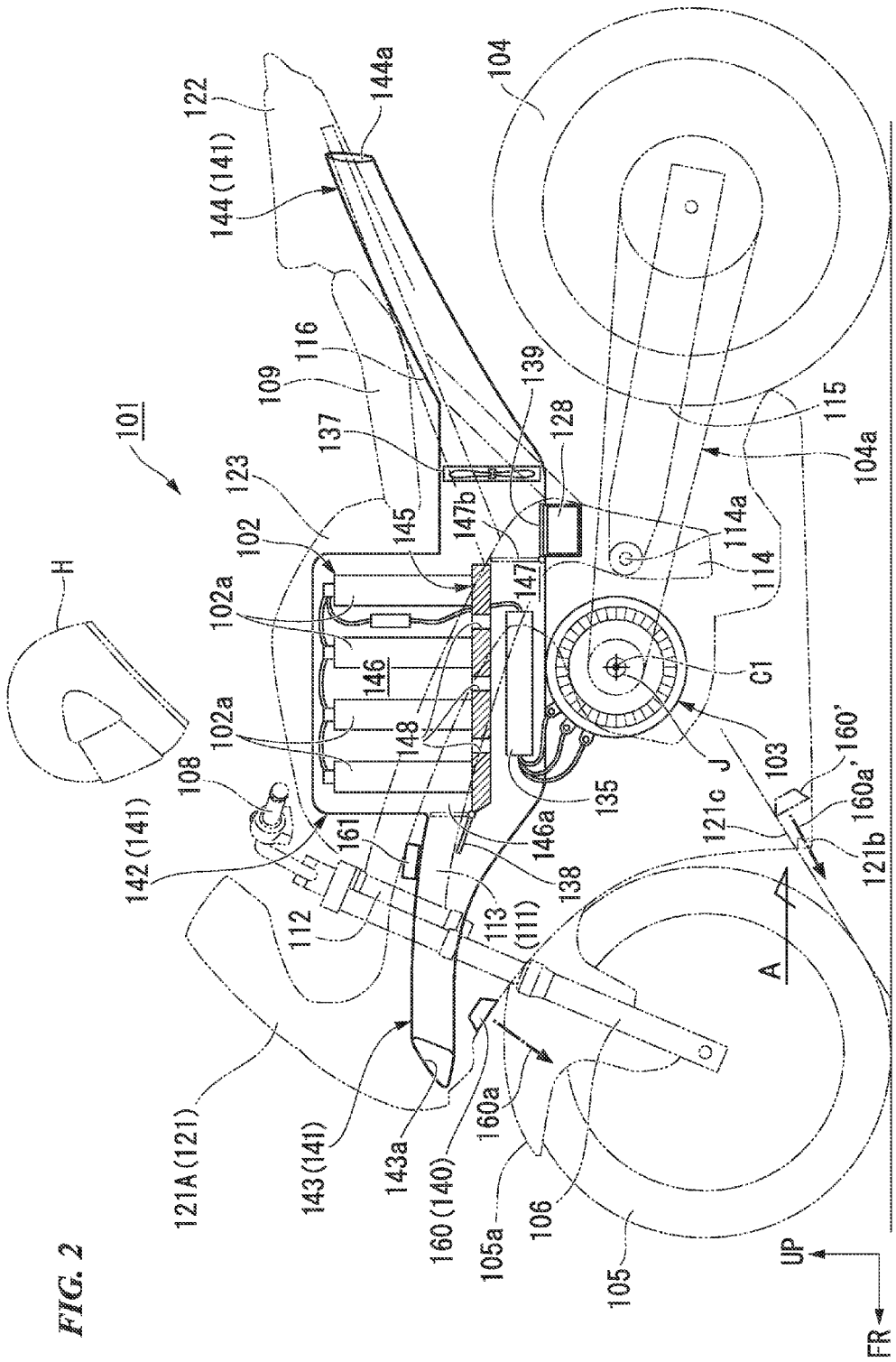
FIG. 1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H
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121A (121)
143 (141)
143a
160 (140)
105a
106
105
160a
112
113
(111)
161
138
146a
135
102
102a
102a
146
148
123
145
147b
147
137
109
116
139
128
144 (141)
144a
122
104
115
104a
114a
114
C1
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J
121c
121b
160a'
160'
A
UP
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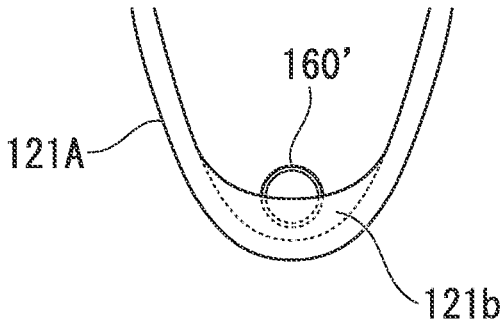
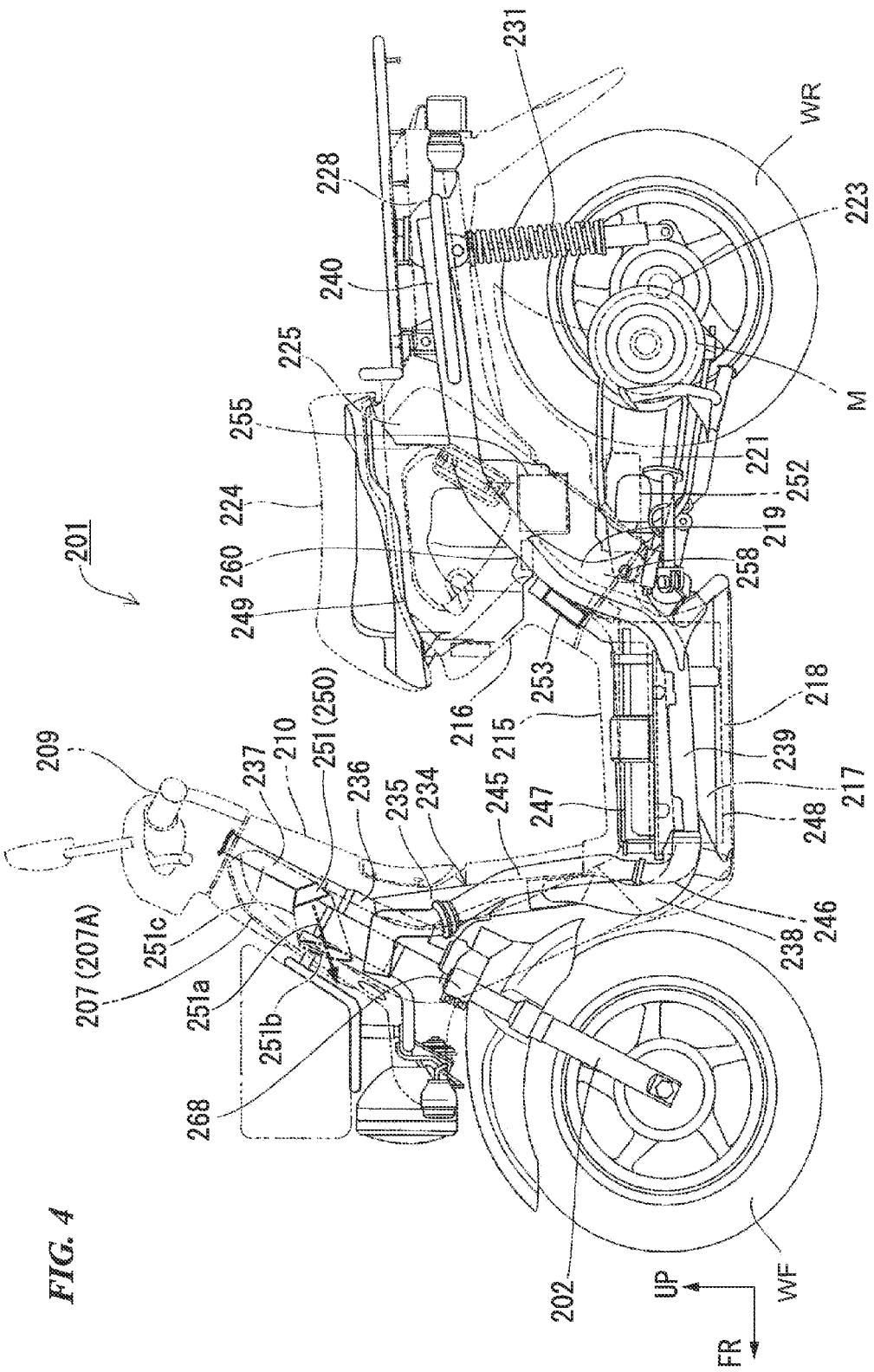
FIG. 2

FIG. 3

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240
225
255
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252
219
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253
216
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209
237
210
251(250)
215
239
236
235
234
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207 (207A)
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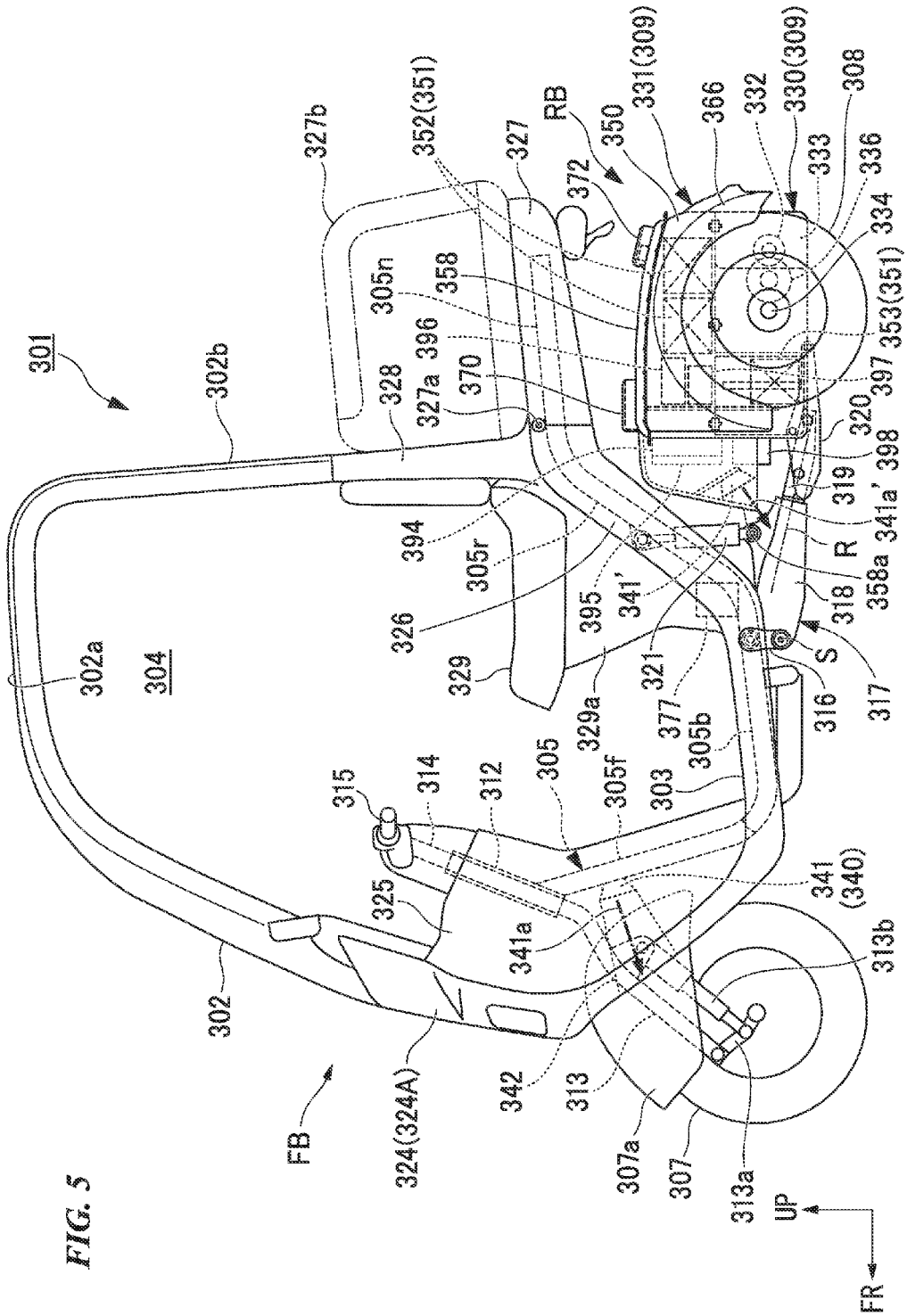
251b
268
238
246
202
UP
FR
WF
M

FIG. 4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302a
302b
304
305
305f
305n
305r
305b
303
307
307a
308
312
313
313a
313b
314
315
316
317
318
319
320
321
324(324A)
325
326
327
327a
327b
328
329
329a
330(309)
331(309)
332
333
334
336
340
341
341a
341'
341a'
342
350
352(351)
353(351)
358
358a
366
370
372
377
394
395
396
397
398
RB
R
S
FB
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FIG. 5

FIG. 6

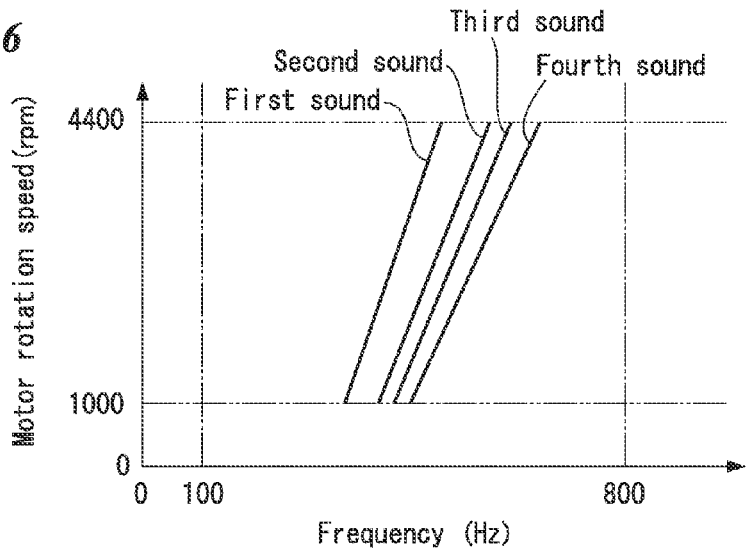


FIG. 7

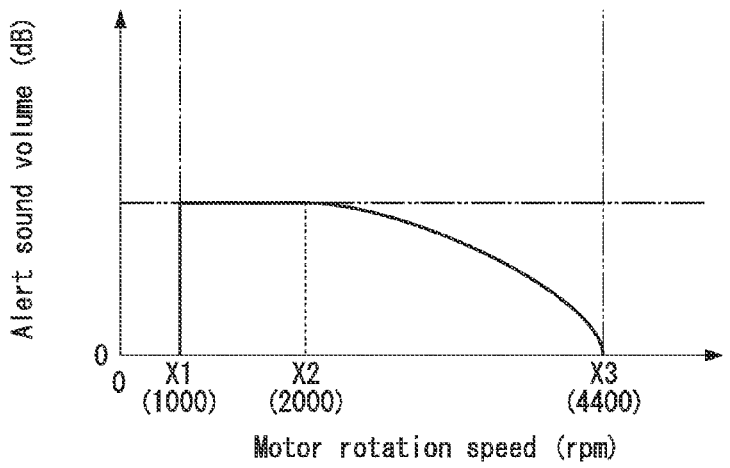
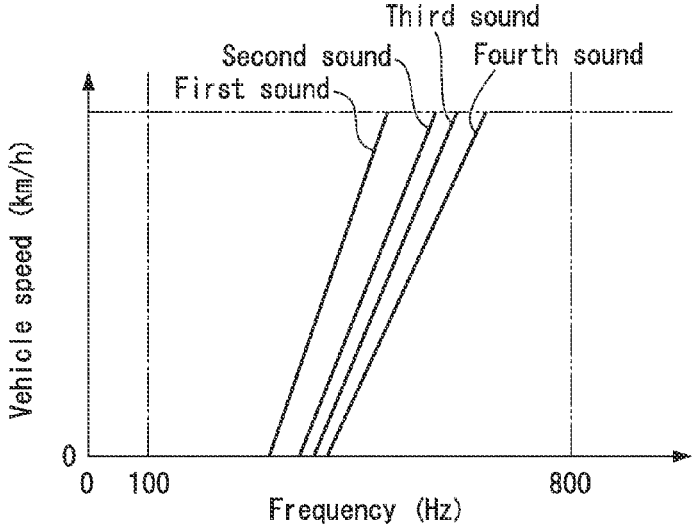


FIG. 8



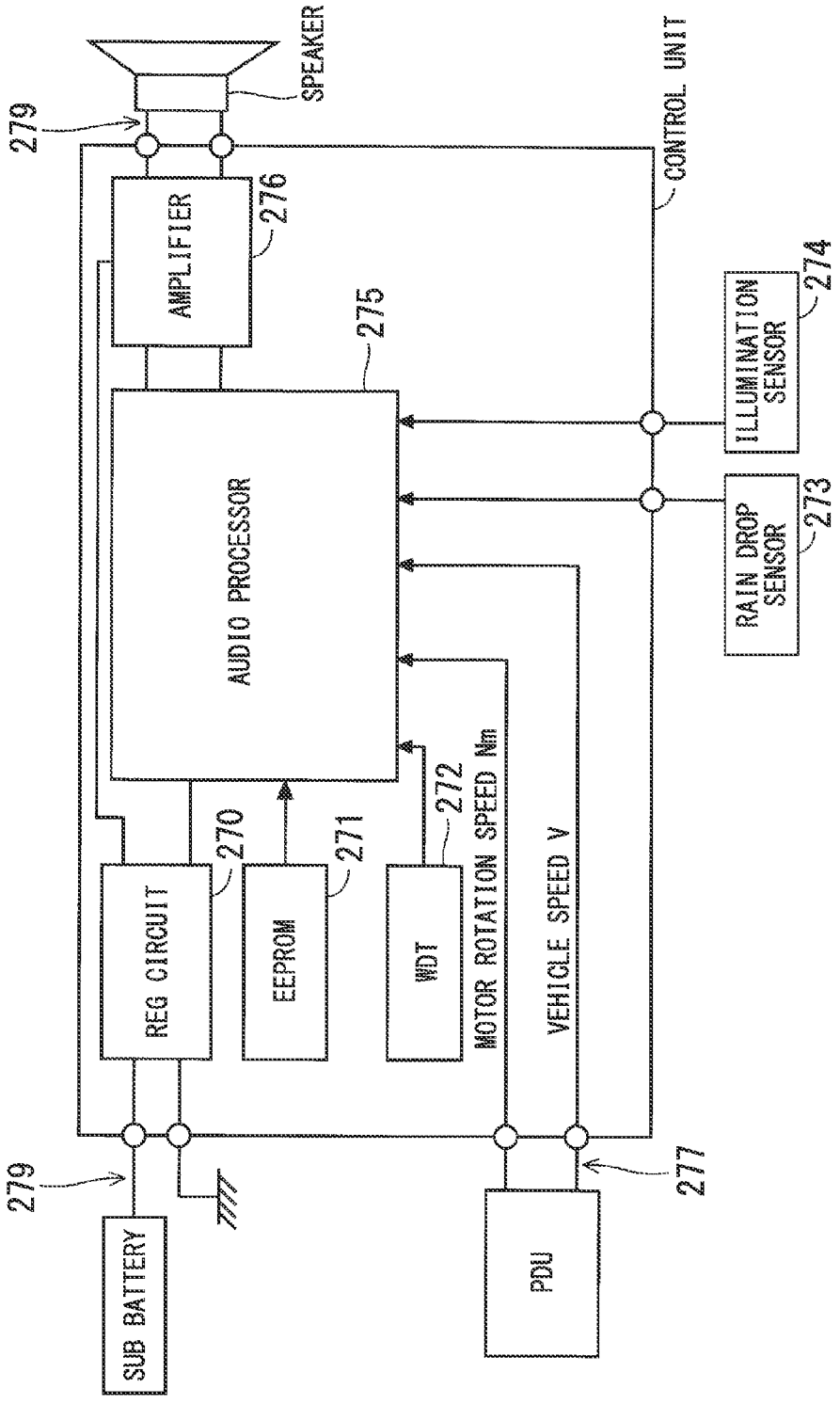
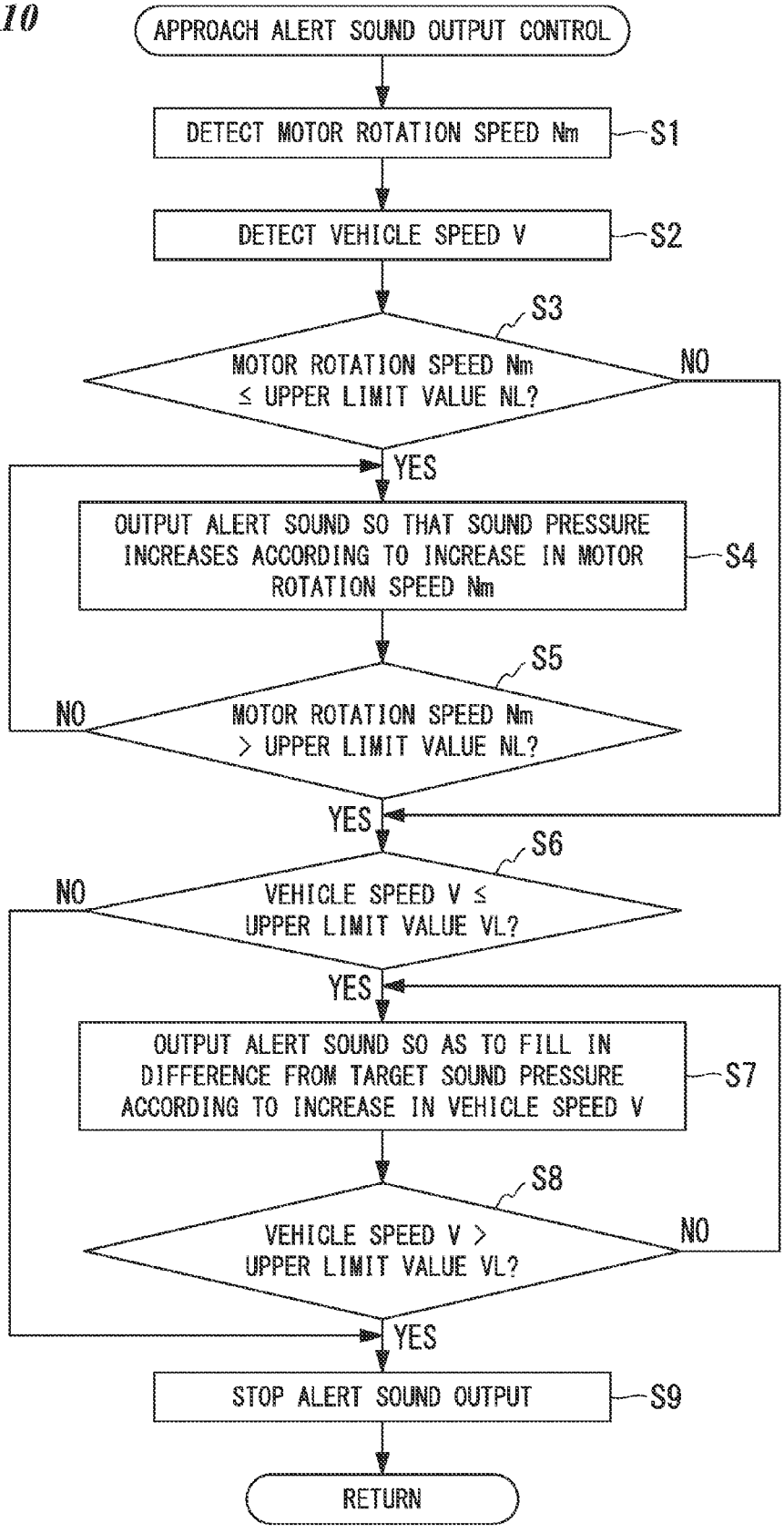
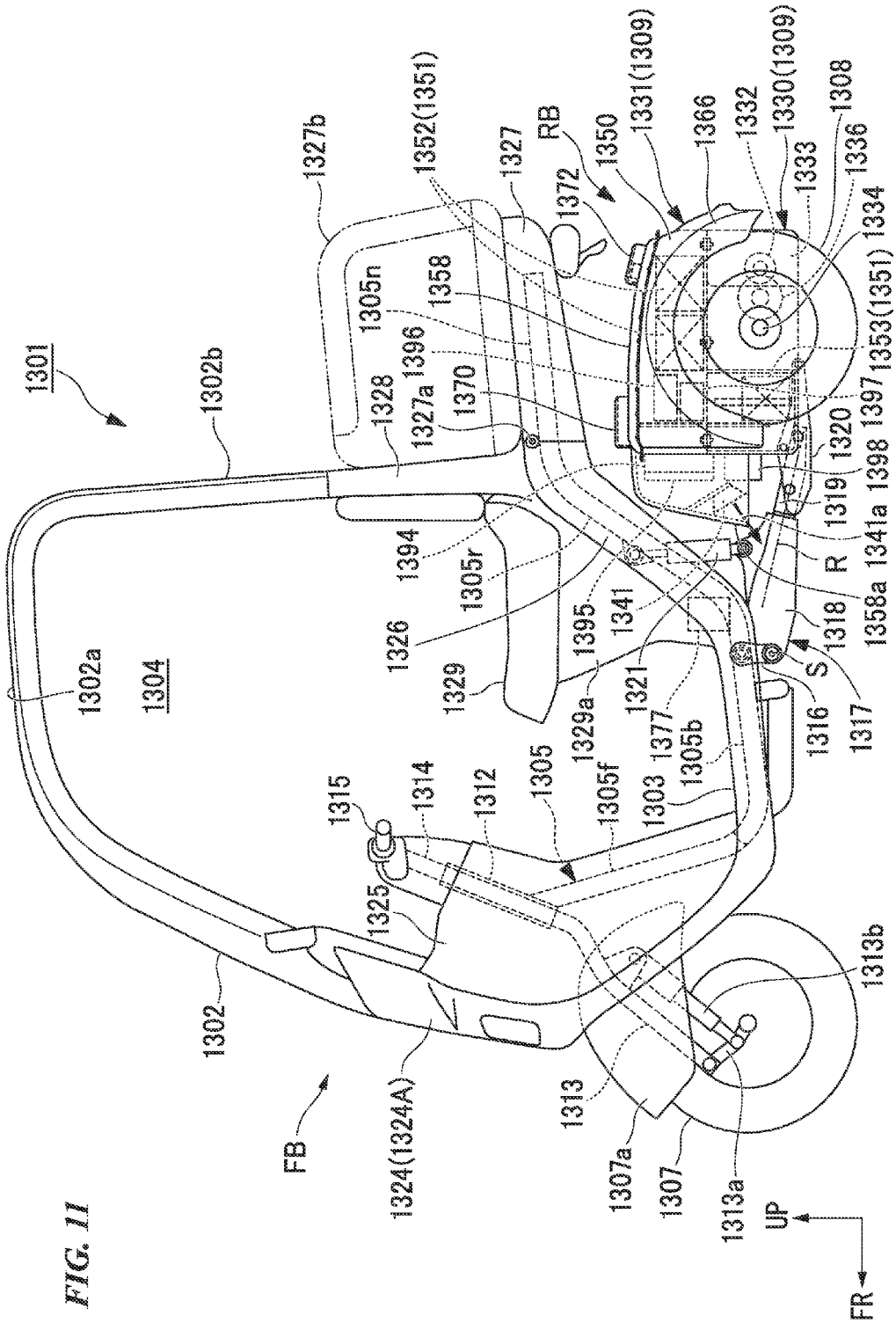

SPEAKER
279
AMPLIFIER
276
275
CONTROL UNIT
ILLUMINATION SENSOR
274
AUDIO PROCESSOR
RAIN DROP SENSOR
273
272
270
271
REG CIRCUIT
EEPROM
WDT
MOTOR ROTATION SPEED Nm
VEHICLE SPEED V
279
277
SUB BATTERY
PDU

FIG. 9

FIG. 10


APPROACH ALERT SOUND OUTPUT CONTROL
DETECT MOTOR ROTATION SPEED Nm
S1
DETECT VEHICLE SPEED V
S2
S3
MOTOR ROTATION SPEED Nm ≤ UPPER LIMIT VALUE NL?
NO
YES
OUTPUT ALERT SOUND SO THAT SOUND PRESSURE INCREASES ACCORDING TO INCREASE IN MOTOR ROTATION SPEED Nm
S4
S5
NO
MOTOR ROTATION SPEED Nm > UPPER LIMIT VALUE NL?
YES
S6
NO
VEHICLE SPEED V ≤ UPPER LIMIT VALUE VL?
YES
OUTPUT ALERT SOUND SO AS TO FILL IN DIFFERENCE FROM TARGET SOUND PRESSURE ACCORDING TO INCREASE IN VEHICLE SPEED V
S7
S8
VEHICLE SPEED V > UPPER LIMIT VALUE VL?
NO
YES
STOP ALERT SOUND OUTPUT
S9
RETURN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1305b
1305f
1305n
1305r
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1307a
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1313a
1313b
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1320
1321
1324(1324A)
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1327a
1327b
1328
1329
1329a
1330(1309)
1331(1309)
1332
1333
1334
1336
1341
1341a
1350
1352(1351)
1353(1351)
1358
1358a
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FIG. 11

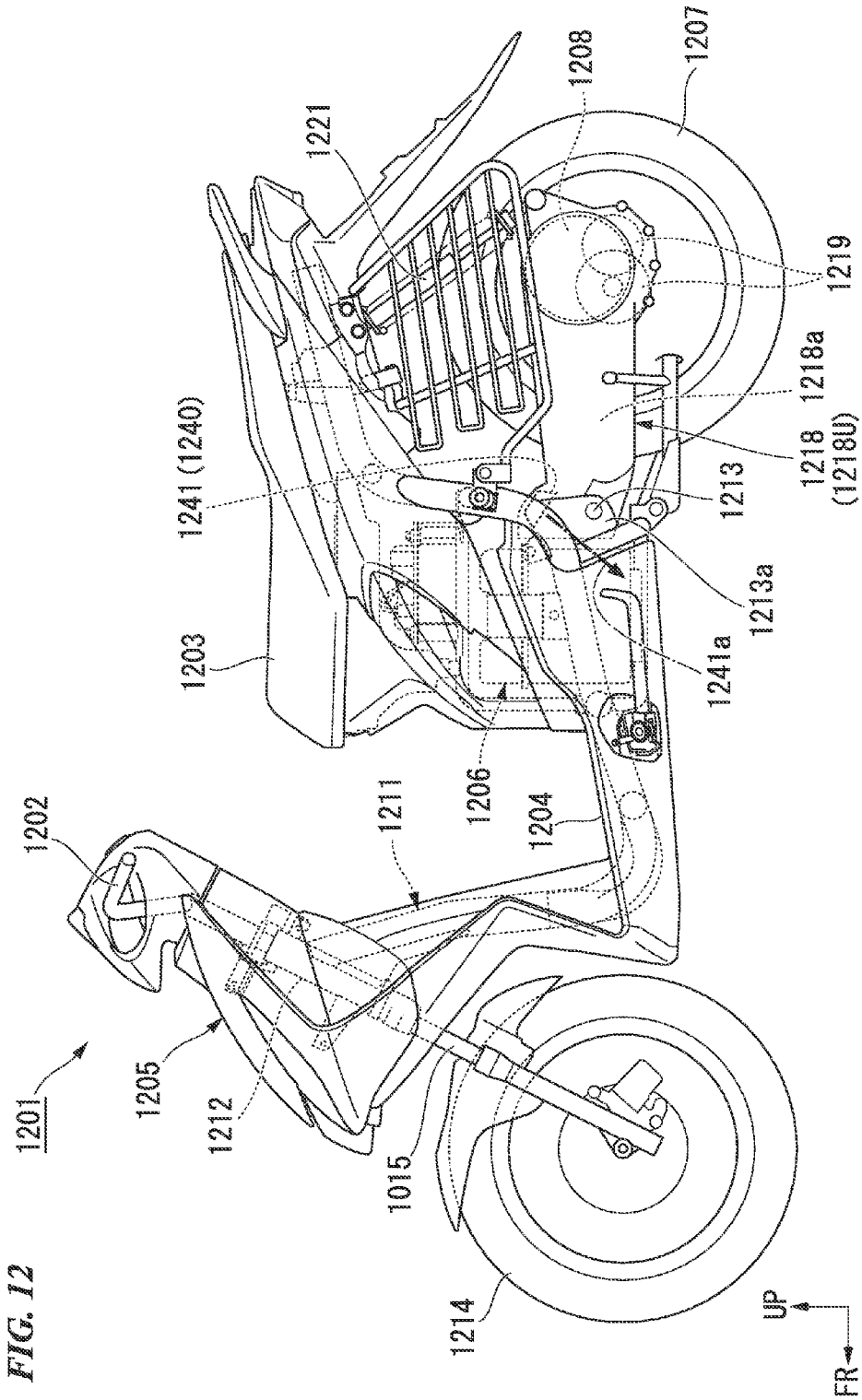
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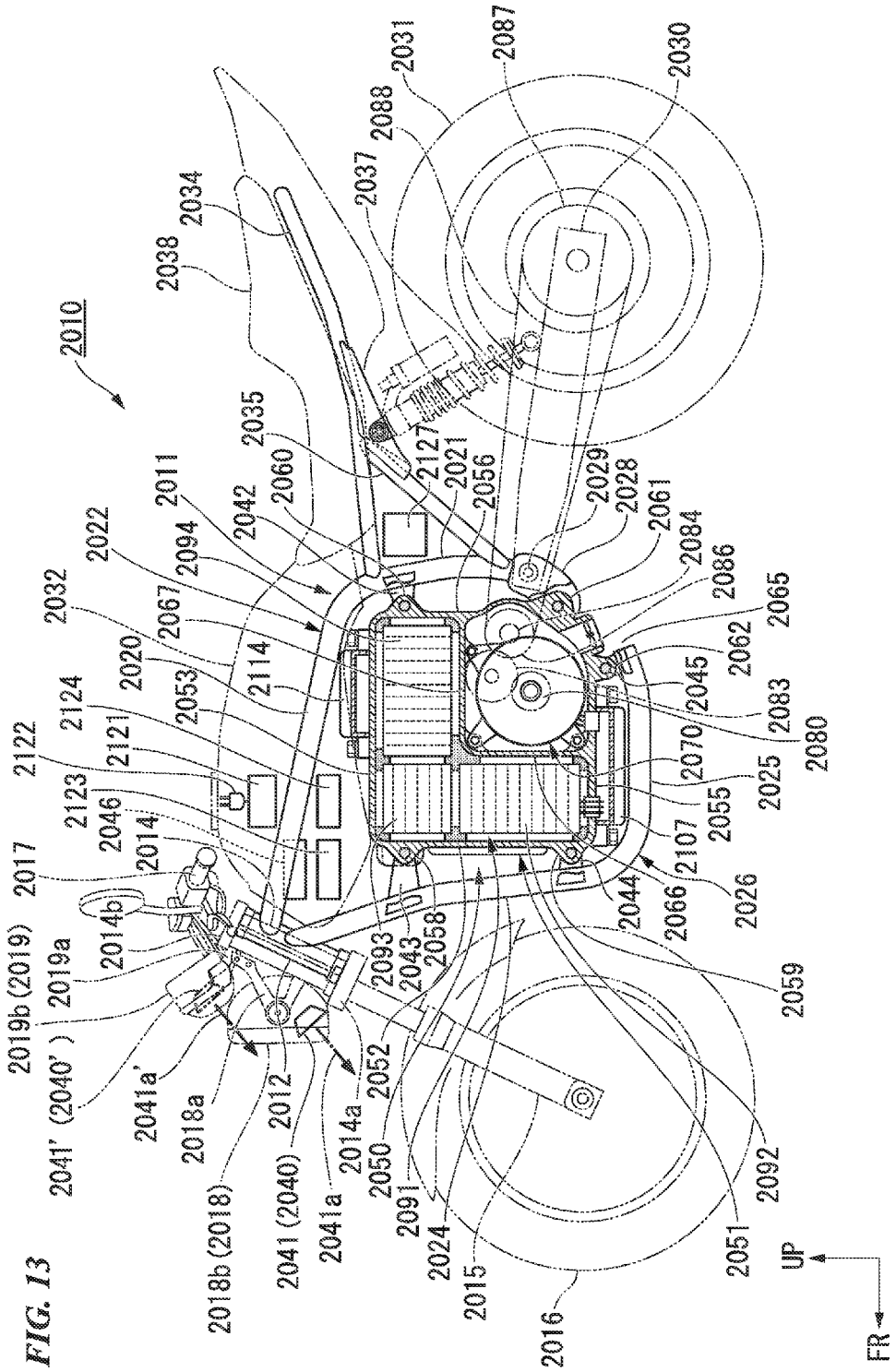
FIG. 12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2021
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2011
2029
2028
2061
2084
2086
2065
2062
2045
2083
2080
2025
2055
2107
2026
2044
2066
2059
2092
2051
2015
2016
2024
2091
2050
2041a
2014a
2052
2012
2041 (2040)
2018b (2018)
2018a
2041a'
2041' (2040')
2019b (2019)
2019a
2014b
2017
2046
2014
2123
2121
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FIG. 13

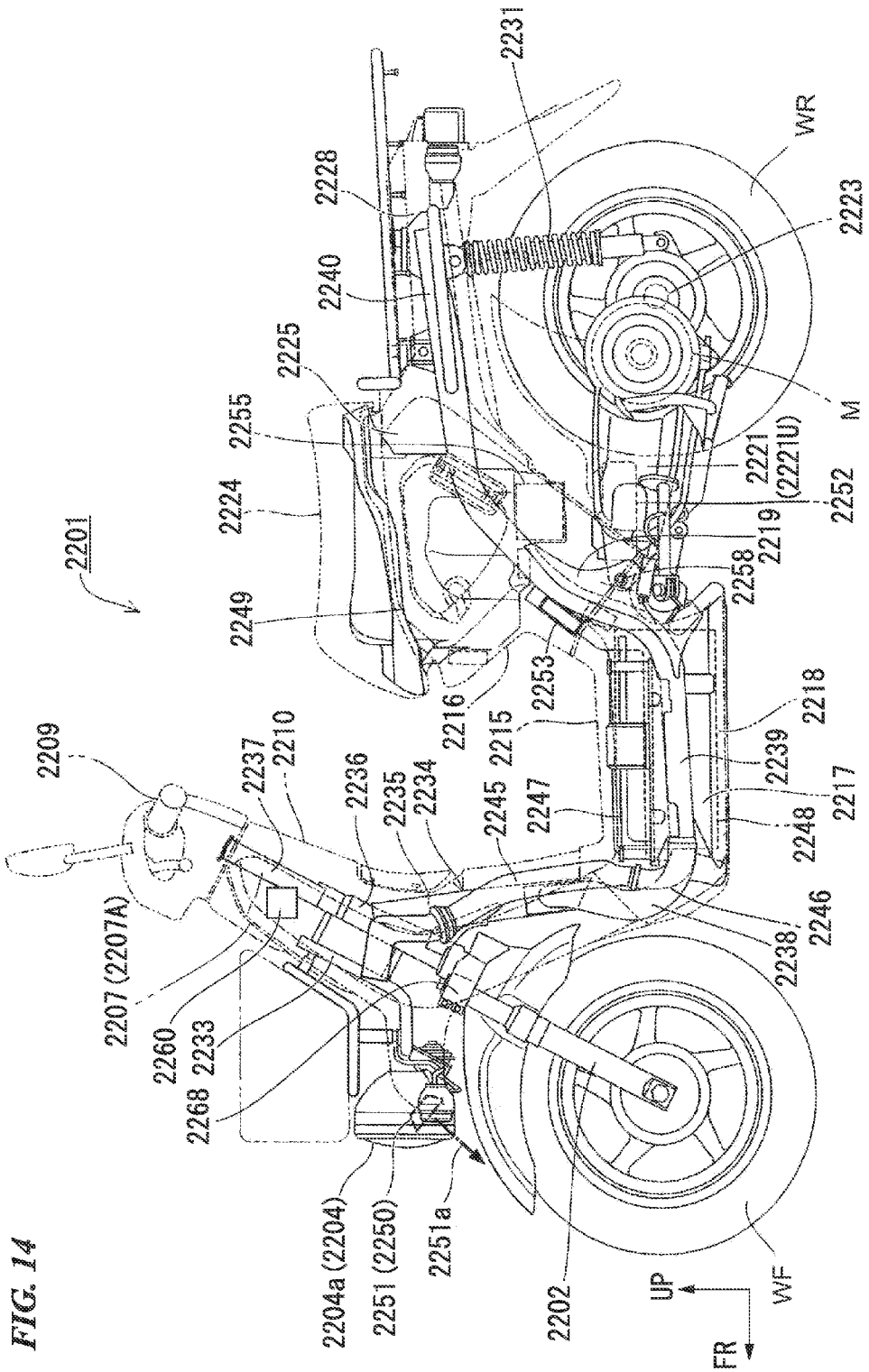
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FIG. 14

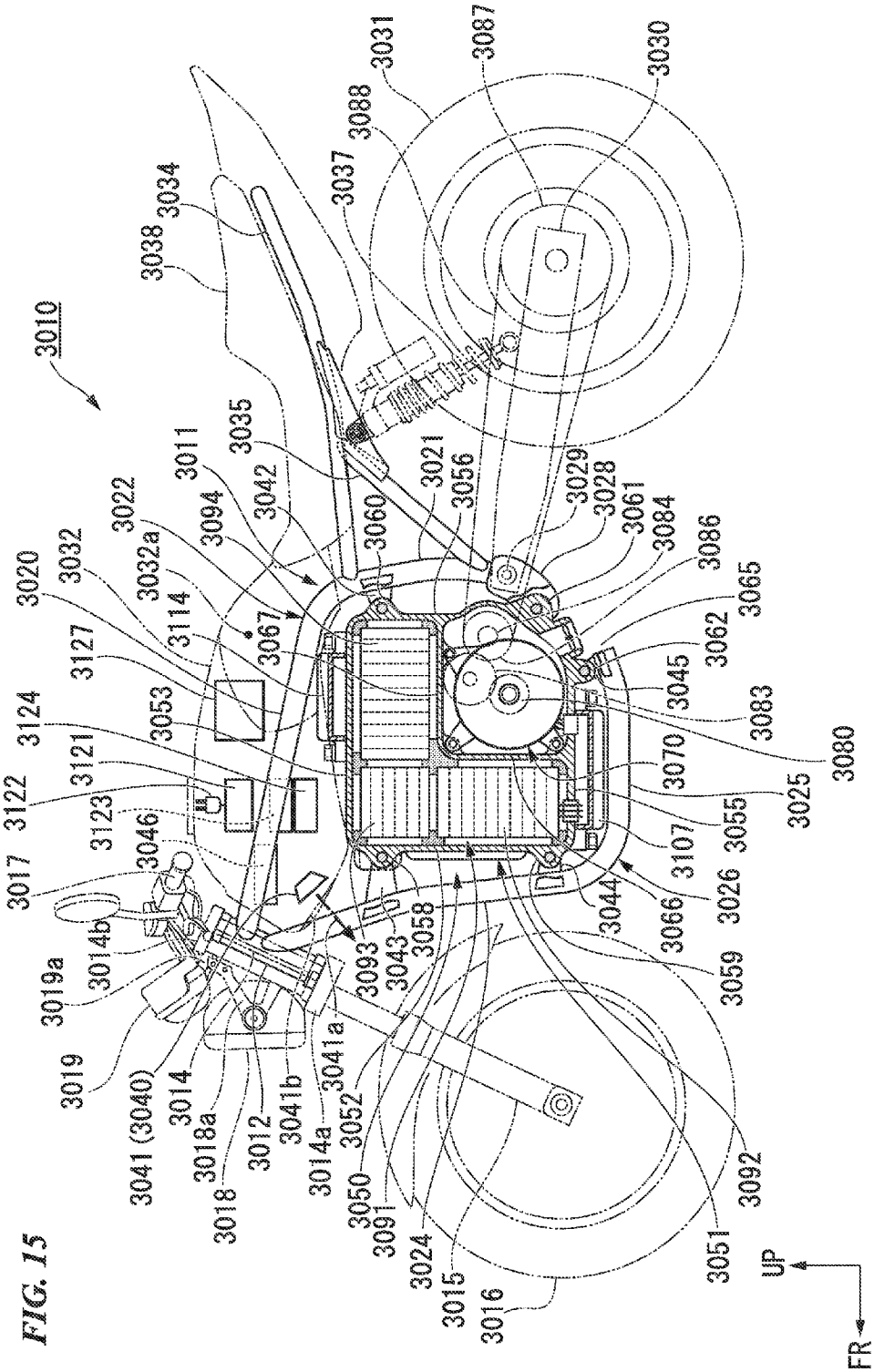
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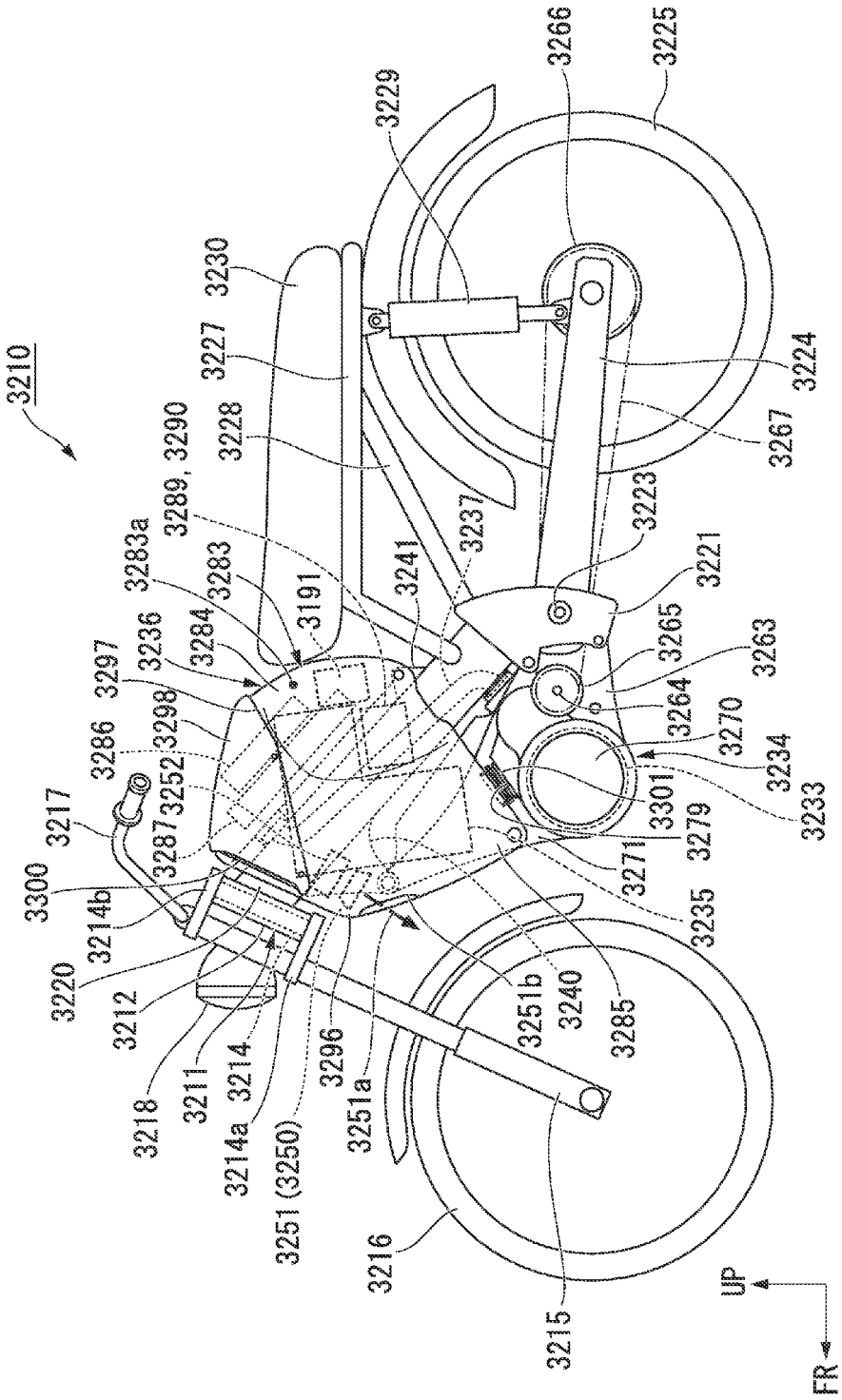
FIG. 15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3191
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3286
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3300
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3240
3212
3285
3218
3211
3214
3214a
3296
3251 (3250)
3251a
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FIG. 16

VEHICLE APPROACH ALERT DEVICE FOR SADDLE-RIDDEN ELECTRIC VEHICLE

TECHNICAL FIELD

The present invention relates to a vehicle approach alert device for a saddle-ridden electric vehicle that outputs an alert sound for notifying of approach of a vehicle.

Priority is claimed on Japanese Patent Application No. 2011-043322, filed Feb. 28, 2011, Japanese Patent Application No. 2011-043323, filed Feb. 28, 2011, Japanese Patent Application No. 2011-043324, filed Feb. 28, 2011, and Japanese Patent Application No. 2011-043325, filed Feb. 28, 2011, the contents of which are incorporated herein by reference.

BACKGROUND ART

In motor vehicles such as electric vehicles and hybrid vehicles, which are being developed in recent years, there is a problem in that it is difficult for pedestrians or other road users to recognize approach of an electric motor powered vehicle due to traveling noise thereof being smaller when it is traveling with an electric motor, compared to traveling noise of an engine powered vehicle, and there is a demand for an appropriate measure to address this problem.

For example, Patent Document 1 below discloses a vehicle approach alert device such that in a hybrid four wheeled vehicle that travels with driving force of an electric motor primarily at low speeds, when the vehicle speed is lower than or equal to a predetermined value and also the brake is detected as being operated, a speaker arranged on the inner side of the bumper at the vehicle body front part outputs an alert sound to thereby notify pedestrians and other road users of approach of this vehicle.

PRIOR ART DOCUMENT

Patent Document

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2008-195137

SUMMARY OF INVENTION

Problems to be Solved by the Invention

However, an application of an excessively large speaker is not possible when attaching a speaker (sound emitter) to a saddle-ridden vehicle such as two wheeled vehicle, which has less surplus space compared to a four wheeled vehicle. Therefore, there is a demand for an arrangement in which a high level of alerting effect can be obtained even when a comparatively small sized speaker is used.

Moreover, in those cases of a comparatively small saddle-ridden vehicle, there is also a problem in that there is a limitation in separating the speaker from the driver, and it is difficult to balance reduction in the magnitude of alert sound to be heard by the driver, and the volume of an alert sound to be delivered to the surrounding area, which is the intended purpose.

In an aspect of the present invention, it is an object to provide a vehicle approach alert device for a saddle-ridden electric vehicle that optimizes the arrangement of a sound emitter that outputs an alert sound for notifying the surrounding area of approach of a vehicle.

Means for Solving the Problem

The aspect of the present invention employs the following aspects in order to solve the above problem and achieve the object. That is to say:

(1) An aspect of the present invention is a vehicle approach alert device for a saddle-ridden electric vehicle that is attached to a vehicle body of a saddle-ridden electric vehicle having an electric motor included in a power engine, and that is provided with a sound emitter that emits an alert sound to a surrounding area for notifying the surrounding area of approach of the saddle-ridden electric vehicle, wherein sound emission of the sound emitter is controlled according to a traveling status of the vehicle, and the sound emitter is arranged so that a direction of the sound emission is oriented diagonally downward and forward of the saddle-ridden electric vehicle.

(2) In the aspect of (1) above, the saddle-ridden electric vehicle may be provided with a front cover that covers the periphery of a head pipe of a vehicle body frame, and the sound emitter may be arranged on an inner side of the front cover.

The saddle-ridden electric vehicle includes electric vehicles in general, over the vehicle body of which a driver straddles to ride on the vehicle, and it includes not only two wheeled vehicles (including scooter type vehicles) but also three wheeled vehicles (including front two wheeled and rear one wheeled vehicles, in addition to front one wheeled and rear two wheeled vehicles) and four wheeled vehicles.

(3) In the aspect of (2) above, the saddle-ridden electric vehicle may be further provided with a sound emission duct that extends diagonally downward and forward from the sound emitter along the sound emission direction, and the sound emitter may be attached to the vehicle body frame, on the inner side of the front cover, and may emit a sound to an outer side of the front cover through the sound emission duct.

(4) In the aspect of either one of (2) and (3) above, the sound emitter may be arranged on the lower side of the head pipe.

(5) In the aspect of (4) above, the sound emitter may be arranged on an outer side of a front fender of the saddle-ridden electric vehicle.

(6) In the aspect of any one of (2) through (5), the saddle-ridden electric vehicle may be further provided with a vehicle body frame member that extends diagonally backward and downward of this saddle-ridden electric vehicle, from the head pipe; on the head pipe there may be steerably supported a front fork that extends diagonally forward and downward and that suspends a front wheel; and the sound emitter may be arranged in front of the vehicle body frame member and at the rear of the front fork when this saddle-ridden electric vehicle is seen from a side.

(7) In the aspect of any one of (2) through (5) above, on the head pipe, there may be steerably supported a front fork that extends diagonally forward and downward and that suspends a front wheel, and the sound emitter may be arranged in front of the front fork when this saddle-ridden electric vehicle is seen from a side.

(8) In the aspect of (1) above, the saddle-ridden electric vehicle may be further provided with a driving unit that supports the electric motor and a driving wheel, and that is connected to the vehicle body frame so as to be able to swing vertically with respect to the vehicle body frame, and the sound emitter may be provided on the driving unit and also at a position below a driver's seat part.

The saddle-ridden electric vehicle includes electric vehicles in general, over the vehicle body of which a driver

straddles to ride on the vehicle, and it includes not only two wheeled vehicles (including scooter type vehicles) but also three wheeled vehicles (including front two wheeled and rear one wheeled vehicles, in addition to front one wheeled and rear two wheeled vehicles) and four wheeled vehicles.

(9) In the aspect of (8) above, the saddle-ridden electric vehicle may be further provided with a unit cover that covers the driving unit, and within the unit cover, there may be arranged the sound emitter.

(10) In the aspect of either one of (8) and (9) above, the saddle-ridden electric vehicle may be a swing type vehicle such that the vehicle body frame swings left and right with respect to the driving unit having a pair of the driving wheels, and the sound emitter may be arranged above a swing mechanism that connects the driving unit and the vehicle body frame.

(11) In the aspect of any one of (8) through (10) above, the saddle-ridden electric vehicle may be further provided with a battery between the pair of driving wheels, and the sound emitter may be arranged in front of the battery.

(12) In the aspect of (1) above, the sound emitter may be arranged on an inner side of an electrical component that is exposed to an outside of the saddle-ridden electric vehicle.

The saddle-ridden electric vehicle includes electric vehicles in general, over the vehicle body of which a driver straddles to ride on the vehicle, and it includes not only two wheeled vehicles (including scooter type vehicles) but also three wheeled vehicles (including front two wheeled and rear one wheeled vehicles, in addition to front one wheeled and rear two wheeled vehicles) and four wheeled vehicles.

(13) In the aspect of (12) above, the electrical component may be arranged in front of a head pipe of the vehicle body frame.

(14) In the aspect of either one of (12) and (13) above, the electrical component may be a head lamp arranged at a front end of the vehicle body.

(15) In the aspect of either one of (12) and (13) above, the electrical component may be a meter unit arranged at a front end of the vehicle body.

(16) In the aspect of (1) above, the saddle-ridden electric vehicle may be further provided, at the rear of a head pipe of a vehicle body frame, with an exterior member having a knee grip part that is to be sandwiched between both knees of the driver, and the sound emitter may be arranged on an inner side of the exterior member.

The saddle-ridden electric vehicle includes electric vehicles in general, over the vehicle body of which a driver straddles to ride on the vehicle, and it includes not only two wheeled vehicles (including scooter type vehicles) but also three wheeled vehicles (including front two wheeled and rear one wheeled vehicles, in addition to front one wheeled and rear two wheeled vehicles) and four wheeled vehicles.

(17) In the aspect of (16) above, the exterior member may have an opening part that opens toward the direction of the sound emission.

(18) In the aspect of either one of (16) and (17) above, the sound emitter may be arranged within a front end part of the exterior member.

(19) In the aspect of any one of (16) through (18) above, a driving control device for the power engine and an output control device for the sound emitter may be arranged within the exterior member.

(20) In the aspect of any one of (16) through (19) above, a battery that serves as a power supply for the sound emitter may be arranged within the exterior member.

(21) In the aspect of any one of (1) through (20) above, the sound emitter may raise a frequency of the alert sound [in proportion to] with an increase in a rotation speed of the electric motor, and an increase rate of this alert sound frequency may be set so as to be lower than an increase rate of the rotation speed of the electric motor.

(22) In the aspect of any one of (1) through (20) above, a sound emission frequency of the sound emitter may be between 100 HZ and 800 HZ.

(23) In the aspect of (21) above, a sound emission frequency of the sound emitter may be between 100 HZ and 800HZ.

Effect of the Invention

According to the aspect of (1) above, by controlling sound emission of the sound emitter according to the traveling status, and orienting the sound emission direction of the sound emitter to the diagonally downward and forward direction, it is possible to efficiently transmit an alert sound to the surrounding area while appropriately utilizing ground sound reflection according to the traveling status.

Moreover, by orienting the sound emission direction to the direction opposite to the driver, it is possible to reduce the magnitude of the alert sound to be heard by the driver.

According to the aspect of (2) above, by orienting the sound emission direction of the sound emitter to the diagonally downward and forward direction, it is possible to efficiently transmit an alert sound to the surrounding area while utilizing ground sound reflection.

Moreover, it becomes possible to arrange the sound emitter within the front cover of the saddle-ridden electric vehicle, the lengthwise space of which is comparatively small while taking ground reflection of an alert sound into consideration, and it becomes possible even with a small sound emitter to obtain a high level of alerting effect.

Furthermore, by arranging the sound emitter distanced from the driver and orienting the sound emission direction thereof to the direction opposite to the driver, it is possible to reduce the magnitude of the alert sound to be heard by the driver.

According to the aspect of (3) above, while arranging the sound emitter inside the front cover, an alert sound can be emitted with a directionality efficiently through the sound emission duct to the outside of the front cover, and it is possible to increase the level of the alerting effect and further reduce the magnitude of the alert sound to be heard by the driver.

According to the aspect of (4) above, the sound emitter can be arranged distanced from the driver and in close proximity to the ground, using the space below the head pipe, which has a comparatively small number of components, and it is possible to reduce the magnitude of an alert sound to be heard by the driver and transmit the alert sound to the surrounding area efficiently, also utilizing ground sound reflection.

According to the aspect of (5) above, it is possible to arrange the sound emitter distanced from the driver, and by arranging the sound emitter at a position that receives a comparatively small amount of mud splash caused by the front wheel, it is also possible to make an advantageous arrangement for waterproofing the sound emitter.

According to the aspect of (6) above, by arranging the sound emitter within the space having a triangular shape in side view, formed below the head pipe by the vehicle body frame member and the front fork, it is possible to efficiently arrange the sound emitter below the head pipe and protect the sound emitter easily.

According to the aspect of (7) above, by arranging the sound emitter below the head pipe and in front of the front

fork, it is possible to arrange the sound emitter distanced from the driver and further reduce the magnitude of an alert sound to be heard by the driver.

According to the aspect of (8) above, by arranging the sound emitter below the driver's seat part and on the driving unit, which is comparatively close to the ground, it is possible to reduce the magnitude of an alert sound to be heard by the driver due to the sound emitter being distanced therefrom, and transmit the alert sound efficiently to the surrounding area using ground sound reflection also.

According to the aspect of (9) above, sound emission of the sound emitter can be diffused within the unit cover to efficiently transmit this sound to the surrounding area, and the sound emitter can be protected easily. Moreover, it is also possible to further reduce the magnitude of an alert sound to be heard by the driver.

According to the aspect of (10) above, it is possible, with a comparatively strong swing mechanism, to suppress mud splash made to the sound emitter from the road surface.

According to the aspect of (11) above, the mass of the driving unit can be concentrated, and the wiring arrangement can be established easily when connecting a battery to the electric motor. Moreover, by arranging the sound emitter in front of the battery, the sound reflection effect of a battery with mass can give an alert sound a forward directionality, while efficiently diffusing the alert sound within the driving unit.

According to the aspect of (12) above, by installing the sound emitter within an electrical component that is exposed to the exterior of the vehicle, it is possible to efficiently transmit an alert sound to the surrounding area and protect the sound emitter easily. Moreover, with the sound emission direction of the sound emitter being oriented downward, an alert sound can be efficiently transmitted to the surrounding area using ground sound reflection, and it is possible to further reduce the magnitude of the alert sound to be heard by the driver.

According to the aspect of (13) above, it is possible to efficiently transmit an alert sound to the area in front of the vehicle, and reduce the magnitude of the alert sound to be heard by the driver.

According to the aspect of either one of (14) and (15) above, sound can be transmitted to the area in front of the vehicle, and the magnitude of sound to be heard by the driver can be reduced. Moreover, it is possible to simplify the structure of the sound emitter by using a waterproof structure for an electrical component.

According to the aspect of (16) above, with the sound emitter being arranged within the exterior member, which is comparatively large, it is possible to make use of the hollow within the exterior member to thereby achieve superior sound transmission, and suppress sound transmission to the upper side (driver side) of the exterior member to thereby reduce the magnitude of sound to be heard by the driver. Moreover, with the sound emitter emitting a sound diagonally downward and forward, it is possible to transmit sound efficiently to the surrounding area, using ground sound reflection. Furthermore, it is possible, with the exterior member, to protect the sound emitter easily.

According to the aspect of (17) above, sound of the sound emitter can be easily emitted to the outside of the cover (diagonally downward and forward), and sound can be transmitted efficiently to the surrounding area using ground sound reflection, while reducing the magnitude of an alert sound to be heard by the driver.

According to the aspect of (18) above, the sound emitter can be placed distanced from the driver, and it is possible to further reduce the magnitude of an alert sound to be heard by the driver.

According to the aspect of (19) above, the sound emitter, the output control device, and the driving control device are arranged in close proximity to each other, and as a result, wiring between these devices can be established easily, and protection of the respective devices can be achieved easily.

According to the aspect of (20) above, the sound emitter and the battery, which serves as a power supply thereof; are arranged in close proximity to each other, and as a result, wiring between them can be established easily.

According to the aspect of (21) above, by raising the sound emission frequency of the sound emitter [in proportion to] with the increase in the rotation speed of the electric motor, the state of acceleration and/or deceleration of the vehicle can be comprehended by pedestrians and other road users, and it is possible, in combination with the arrangement of the sound emitter, to obtain a high level of alerting effect even with a small sound emitter.

Moreover, by making the increase rate of the alert sound frequency lower than the increase rate of the electric motor rotation speed, it is possible to make the surroundings recognize acceleration of the vehicle while setting the alert sound at a favorable tone range that also has a high level of alerting effect.

According to the aspect of either one of (22) and (23) above, with the alert sound frequency being set within a range between 100 HZ and 800 HZ, it is possible, in combination with the arrangement of the sound emitter, to emit a sound that can be easily heard by and is favorable to people of any age group, using a small sound emitter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a first embodiment of the present invention is applied.

FIG. **2** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a second embodiment of the present invention is applied.

FIG. **3** is a view on arrow A of FIG. **2**.

FIG. **4** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a third embodiment of the present invention is applied.

FIG. **5** is a left side view of a three wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a fourth embodiment of the present invention is applied.

FIG. **6** is a graph showing the relationship between frequency of the alert sound and rotation speed of the electric motor in each embodiment.

FIG. **7** is a graph showing the relationship between sound volume of the alert sound and rotation speed of the electric motor in each embodiment.

FIG. **8** is a graph as a modified example of control shown in FIG. **6**, showing the relationship between frequency of the alert sound and vehicle speed.

FIG. **9** is a block diagram showing a configuration of a speaker control unit in the electric motor.

FIG. **10** is a flow chart showing steps of an alert sound output control.

FIG. **11** is a left side view of a three wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a fifth embodiment of the present invention is applied.

FIG. **12** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a sixth embodiment of the present invention is applied.

FIG. **13** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a seventh embodiment of the present invention is applied.

FIG. **14** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in an eighth embodiment of the present invention is applied.

FIG. **15** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a ninth embodiment of the present invention is applied.

FIG. **16** is a left side view of a two wheeled vehicle to which a vehicle approach alert device for a saddle-ridden electric vehicle in a tenth embodiment of the present invention is applied.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereunder, embodiments of the present inventions are described, with reference to the figures. The upward orientation and the forward orientation in each figure correspond to the orientation of the arrow illustrated in each figure. Moreover, the left-right direction and the front-rear direction refer to the direction viewed from the driver.

<First Embodiment>

First, a first embodiment of the present invention is described, with reference to FIG. **1**.

A two wheeled vehicle **10** illustrated in FIG. **1** that serves as a saddle-ridden electric vehicle is a scooter type vehicle having a low floor part (straddling part) L at a lengthwise intermediate part of the vehicle body. The two wheeled vehicle **10** has a main battery **80** for traveling mounted on the inner side of the low floor part L, and a motor unit (electric motor, power engine) **38** for traveling mounted immediately rear of the main battery **80**, and the motor unit **38** is driven with electric power supplied from the main battery **80**, and the driving force is transmitted to a rear wheel **35** for the two wheeled vehicle **10** to travel. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

A vehicle body frame **11** of the two wheeled vehicle **10** has, at the front end part thereof, a head pipe **12** that is tilted backward with respect to the perpendicular direction. An upper part of a front fork **15** with a pair of left and right portions that axially supports a front wheel **16** on a lower end part, is steerably supported on the head pipe **12** via a steering stem **14** that is turnably inserted into this head pipe **12**, and a bottom bridge **13** that is fixed at the lower end thereof. The upper part of the steering stem **14** projects to the upper side of the head pipe **12**, and a handle bar **17** is attached on this projecting portion. At the lower part of the front fork **15** with left and right portions, there is attached a front fender **16***a* that suppresses mud and road debris from being splashed or thrown up by the front wheel **16**.

On the lower side of the rear part of the vehicle body frame **11**, there is swingably supported, via a pivot shaft **33** along the vehicle widthwise direction (left-right direction), the front end part of a swing arm **34** that is tilted backward and downward with respect to the horizontal direction, and a rear wheel **35** is axially supported on the rear end part of this swing arm **34**. Immediately in front of the pivot shaft **33**, there is arranged a motor unit **38** that has a driving shaft **42** along the vehicle lengthwise direction, and the rear end part of the driving shaft **42** of this motor unit **38** and the front end part of the drive shaft **52** that is inserted into the swing arm **34** are connected via a constant velocity joint **53**. The rear end part of the drive shaft **52** is engaged with the rear wheel **35** via, for example, a bevel gear mechanism **57**, so as to be able to transmit power the rear wheel **35**.

The vehicle body frame **11** has a pair of left and right upper down frames **20** that extend diagonally downward and backward and branch to the left and right from the rear part of the head pipe **12**, and a pair of left and right lower down frames (vehicle body frame member) **21** that, below each of these upper down frames **20**, extend diagonally downward and backward and branch to the left and right from the rear part of the head pipe **12**.

After extending diagonally downward and backward from the head pipe **12**, the upper down frames **20** are bent so as to diminish the inclination thereof at an upper intermediate bent part **20***a* positioned on the inner side of the low floor part L, and then they further extend diagonally downward and backward. Hereunder, the forward portion from the upper intermediate bent part **20***a* of the upper down frames **20** is referred to as an upper front inclined part **20***b*, and the backward portion is referred to as an upper rear inclined part **20***c*.

The lower down frames **21** extend diagonally downward and backward from the head pipe **12** at an angle steeper than that of the upper front inclined part **20***b*, and they are bent at an angle with a further increased inclination, at a first bent part **21***a* that is positioned on the inner side of the low floor part L and diagonally upward and forward of the upper intermediate bent part **20***a*. Then they are bent backward at a second bent part **21***b* that is positioned on the lower end front side of the vehicle body frame **11**. Then, the lower down frames **21** extend backward while maintaining being substantially parallel with each other, and they are bent and extend diagonally upward and backward at a third bent part **21***c* that is positioned diagonally downward and forward of the pivot shaft **33**. Then, the rear upper ends of the lower down frames **21** are connected to the lengthwise intermediate part lower side of left and right seat rails **23**.

Hereunder, the portion of the lower down frames **21** from the head pipe **12** to the first bent part **21***a* is referred to as a first inclined part **22***a*, the portion from the first inclined part **22***a* to the second bent part **21***b* is referred to as a second inclined part **22***b*, the portion from the second bent part **21***b* to the third bent part **21***c* is referred to as a lower end horizontal part **22***c*, and the portion from the third bent part **21***c* to the seat rail **23** is referred to as a rear inclined part **22***d*.

To the lower part front side of the rear inclined part of the lower down frame **21**, there is connected the rear end of the upper down frame **20**. As a result, in the vehicle body frame **11**, there are formed a pair of left and right loop structures that each connect between the head pipe **12** and the pivot shaft **33**.

To the lengthwise intermediate part upper side of the upper rear inclined part **20***c* of the upper down frame **20**, there is connected the front end of the seat rail **23** that extends backward and upward at an angle. To the lengthwise intermediate part lower side of the left and right seat rails **23**, there is connected the upper end of the rear inclined part **22***d* of the lower down frame **21**, and with this, there are formed a pair of

left and right loop structures that forms a triangular shape in side view, diagonally forward and upward of the pivot shaft **33** when seen on a side view.

Seat rails **23** extend to the close vicinity of the vehicle body rear end, and a seat **30** for a driver to sit thereon and a rear part vehicle body cover are supported on these seat rails **23**. The respective frame members on the left and right in the vehicle body frame **11** are appropriately connected via a cross member (not shown in the figure).

On the rear part of the lower end horizontal part **22***c* of the lower down frame **21**, there is swingably supported the front end part of a rear cushion unit **67** that is arranged substantially horizontal, and the rear end part of this rear cushion unit **67** is connected to the front part lower side of the swing arm **34** via a link mechanism **62**.

Above the rear end part of the upper down frame **20**, there are arranged gusset plates **26** that are connected to and straddle over the rear inclined part **22***d* of the lower down frame **21**, and the motor unit **38** is supported between the left and right gusset plates **26**. The motor unit **38** accommodates an electric motor (power engine) **41** within a unit case **39** that forms the exterior appearance thereof.

Above the motor unit **38**, a PDU (power driver unit) **50** is arranged in close proximity thereto. The PDF **50** is arranged at the front part of the seat rails **23**, and within the loop structure shaped in a triangular shape in side view, that is surrounded by the rear end part of the upper rear inclined part **20***c* of the upper down frame **20** and the rear inclined part **22***d* of the lower down frame **21**.

Inside the vehicle body frame **11**, there is arranged the rectangular-solid-shaped main battery **80**, which is long in the lengthwise direction, so as to fit in between the upper rear inclined part **20***c* of the upper down frames **20**, and between the second inclined parts **22***b* and the lower end horizontal parts **22***c* of the lower down frames **21**. The main battery **80** is a high voltage battery of 48 to 72V for supplying electric power to the electric motor **41**, and is mounted on the vehicle body frame **11** in a state of being housed within a battery case **70**, which is of a rectangular sold shape similar to that of the main battery **80**.

Here, reference symbol **43** in the figure denotes a front cover body that covers the periphery of the head pipe **12** from the front side, reference symbol **44** denotes a front inner cover that covers the periphery of the head pipe **12** from the rear side, reference symbol **45** denotes a floor cover that covers the periphery of the upper and lower down frames **20** and **21** from the upper side, above the low floor part L, reference symbol **46** denotes a lower cover that covers the periphery of the upper and lower down frames **20** and **21** from the lower side, below the low floor part L, and reference symbol **47** denotes a vehicle body rear part cover that covers the vehicle body rear part at rear of the low floor part L and below the seat **30**.

The front cover body **43** and the front inner cover **44** are fitted with each other in the lengthwise direction to thereby form a front cover **43**A that covers the vehicle body front part including the periphery of the head pipe **12**. The front cover **43**A is provided in a range that substantially covers from the top to the bottom of the vehicle body cover front part in the vertical direction, and that substantially covers from the front end of the vehicle body cover to the front end of the low floor part L in the lengthwise direction.

In the front cover **43**A, there is provided an air inlet opening **83** that opens forward, and there is provided an air inlet duct **84** that communicates with the air inlet opening **83**. The rear end part of the air inlet duct **84** is connected to the front part upper end of the battery case **70**. At the rear part lower end of the battery case **70**, there is provided an air exhaust opening **85**. Air that has been introduced from the air inlet opening **83** into the battery case **70** through the air inlet duct **84** cools the main battery **80**, and then is discharged to the outside of the case (outside of the vehicle) from the air exhaust opening **85**.

The air inlet duct **84** is capable of introducing traveling airstream into the battery case **70** when the vehicle is traveling. On the other hand, it introduces outside air into the battery case **70** by the operation of a built-in electric fan **86** when the vehicle is in a stop state.

On the inner side of the air inlet duct **84** and on the upstream side of the electric fan **86**, there is arranged a DC-DC converter **88**, which generates a comparatively large amount of heat. On the upper side of the DC-DC converter **88**, and for example, on the outer side of the air inlet duct **84**, there is arranged a control unit **89** for output control of a speaker **48** that is described later. On the inner side of the low floor part L and on the upper side of the battery case **70**, there is arranged a 12V sub battery **87**.

In the front surface part of the front cover **43**A, there is provided a recharge socket **90** to which an external power supply plug of, for example, AC100V can be connected, and on the inner side of the front cover **43**A and on the front side of the head pipe **12**, there is provided a recharger **91** which is capable of recharging the main battery **80** using an external power supply connected to the recharge socket **90**.

90Here, the two wheeled vehicle **10** is provided with a vehicle approach alert device **40** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, the speaker **48**, which is a sound emitter for emitting an alert sound, is arranged on the inner side of the front cover **43**A and below the lower end of the head pipe **12**, and it is attached on the front side of one or both of the first inclined parts **22***a* of the left and right lower down frames **21**. The speaker **48** is arranged within the space having a triangular shape with the front fork **15** and the first and second inclined parts **22***a* and **22***b* of the lower down frame **21** being the upper two edges thereof when viewed from a side.

The sound emission direction of the speaker **48** (sound emission direction, shown with arrow **48***a* in the figure) is oriented diagonally downward and forward, and in this sound emission direction **48***a* (diagonally downward and forward of the speaker **48**), there is provided a bell-bottom-shaped sound emission duct **49** that extends diagonally downward and forward while tapering outward, along the sound emission direction **48***a*. The end part of the sound emission duct **49** opens to the outside of the front cover **43**A, and it gives a directionality to sound to be emitted from the speaker **48** and emits the sound diagonally downward and forward of the front cover **43**A.

The sound emission direction **48***a* of the speaker **48** is approximately oriented to the traveling direction of the two wheeled vehicle **10**, and the sound of the speaker **48** can be recognized by pedestrians and other road users easily. On the other hand, the sound emission direction **48***a* is oriented to the direction of moving away from the head part H of the driver, and therefore, the magnitude of the sound of the speaker **48** to be heard by the driver is suppressed. The sound volume of the speaker **48** is controlled by the control unit **89** according to the vehicle speed and so forth. Electric power is supplied from the sub battery **87** to the speaker **48** and the control unit **89**.

The speaker **48** and the sound emission duct **49** are positioned diagonally upward and backward of the front wheel **16**. However, the portion that is diagonally upward and backward of the front wheel **16** is covered by the front fender **16***a*.

That is to say, since the speaker **48** is positioned on the outer circumferential side of the front fender **16***a*, rain water and so forth splashed by the front wheel **16** are unlikely to come in contact with the speaker **48** and the sound emission duct **49**. There is no particular limitation to the number of speakers **48** to be installed. The outer circumferential side of the front fender refers to the radially outer side of the outer circumference part of the front fender when seen from the side.

As has been described above, the vehicle approach alert device **40** of a saddle-ridden electric vehicle in the above embodiment is one that outputs an alert sound toward the surrounding area from the speaker **48** attached on the vehicle body of the two wheeled vehicle **10**, to thereby notify the surrounding area of approach of the two wheeled vehicle **10**, and the speaker **48** is arranged so that the sound emission direction **48***a* is oriented diagonally downward and forward.

According to this configuration, by controlling sound emission of the sound emitter according to the traveling status, and orienting the sound emission direction **48***a* of the speaker **48** to the diagonally downward and forward direction, it is possible to efficiently transmit an alert sound to the surrounding area while appropriately utilizing ground sound reflection according to the traveling status.

Moreover, by orienting the sound emission direction **48***a* to the direction opposite to the driver, it is possible to reduce the magnitude of the alert sound to be heard by the driver.

Furthermore, the vehicle approach alert device **40** is such that the two wheeled vehicle **10** is provided with the front cover **43**A that covers the periphery of the head pipe **12** of the vehicle body frame **11** thereof, and the speaker **48** is arranged inside the front cover **43**A, with the sound emission direction **48***a* thereof being oriented diagonally downward and forward.

According to this configuration, by orienting the sound emission direction **48***a* of the speaker **48** to the diagonally downward and forward direction, it is possible to efficiently transmit an alert sound to the surrounding area while utilizing ground sound reflection.

Moreover, it becomes possible to arrange the speaker **48** within the front cover **43**A of the two wheeled vehicle **10**, the lengthwise space of which is comparatively small while taking ground reflection of an alert sound in to consideration, and it becomes possible even with a small speaker **48** to obtain a high level of alerting effect.

Furthermore, by arranging the speaker **48** distanced from the driver and orienting the sound emission direction **48***a* thereof to the direction opposite to the driver, it is possible to reduce the magnitude of the alert sound to be heard by the driver.

Moreover, the vehicle approach alert device **40** is provided with the sound emission duct **49** that extends diagonally downward and forward from the speaker **48** along the sound emission direction **48***a* thereof, and the speaker **48**, on the inner side of the front cover **43**A, is attached on the vehicle body frame **11**, and emits sound to the outside of the front cover **43**A through the sound emission duct **49**.

According to this configuration, while arranging the speaker **48** inside the front cover **43**A, an alert sound can be emitted with a directionality efficiently through the sound emission duct **49** to the outside of the front cover **43**A, and it is possible to increase the level of alerting effect and further reduce the magnitude of the alert sound to be heard by the driver.

Moreover, the vehicle approach alert device **40** is such that the speaker **48** is arranged below the head pipe **12**.

According to this configuration, the speaker **48** can be arranged distanced from the driver and in close proximity to the ground, using the space below the head pipe **12**, which has a comparatively small number of components, and it is possible to reduce the magnitude of an alert sound to be heard by the driver and transmit the alert sound to the surrounding area efficiently, also utilizing ground sound reflection.

Moreover, the vehicle approach alert device **40** is such that the speaker **48** is arranged on the outer circumferential side of the front fender **16***a* of the two wheeled vehicle **10**.

According to this configuration, it is possible to arrange the speaker **48** distanced from the driver, and by arranging the speaker **48** at a position that receives a comparatively small amount of mud splash caused by the front wheel **16**, it is also possible to make an advantageous arrangement for waterproofing the speaker **48**.

Furthermore, the vehicle approach alert device **40** is characterized in that it is provided with the lower down frames **21** each extending diagonally backward and downward from the head pipe **12**; on the head pipe **12** there is steerably supported the front fork **15** that extends diagonally forward and downward and that suspends the front wheel **16**; and the speaker **48** is arranged in front of the first and second inclined parts **22***a* and **22***b* of the lower down frame **21** when viewed from the side, and at the rear of the front fork **15**.

According to this configuration, with the speaker **48** being arranged, below the head pipe **12**, within the space having the triangular shape in side view, with the first and second inclined parts **22***a* and **22***b* of the lower down frame **21** and the front fork **15** being the two edges thereof, it is possible to efficiently arrange the speaker **48** below the head pipe **12**, and protection of the speaker **48** can be achieved easily.

Reference symbol **48'** in the figure denotes a speaker arranged on the front edge of the front cover **43**A, and reference symbol **48***a'* denotes a sound emission direction of this speaker **48'**. The sound emission direction **48***a'* of the speaker **48'** is oriented diagonally downward and forward, and the sound thereof is directly emitted toward the outside of the front cover **43**A (toward the front side of the vehicle and in the traveling direction). According also to this configuration, in addition to the action and effect similar to those described above, sound of the speaker **48'** can be efficiently emitted to the outside of the cover with the sound emission duct having been eliminated.

<Second Embodiment>

Next, a second embodiment of the present invention is described, with reference to FIG. **2** and FIG. **3**.

A two wheeled vehicle **101** shown in FIG. **2** that serves as a saddle-ridden electric vehicle is such that: at the center upper part of the vehicle body thereof there is mounted a main battery **102** for traveling; at the center lower part of the vehicle body there is mounted a motor unit **103** for traveling; the motor unit **103** is driven with electric power supplied from the main battery **102**; and the driving force is transmitted to a rear wheel **104**, which is a driving wheel, for traveling. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

The two wheeled vehicle **101** has an aspect of a sport type motorcycle, which allows the driver to carry out knee gripping, and a front wheel **105** is axially supported at the lower end part of a pair of left and right portions of a front fork **106**, while the upper part of the front fork **106** with the left and right portions is steerably and pivotably supported on a head pipe **112** at the front end of the vehicle body frame **111** via a steering stem (not shown in the figure). At the upper part of the steering stem (or the front fork **106**), there is attached a steering handle bar **108**.

A pair of left and right main frames **113** extend diagonally downward and backward from the head pipe **112**, and a pivot

frame **114** extends downward from the rear end part of the left and right main frames **113**. On the left and right pivot frames **114**, via a pivot shaft **114***a*, there is vertically swingably and pivotably supported the front end part of a swing arm **115**, and at the rear end part of the swing arm **115**, there is axially supported the rear wheel **104**.

The vehicle body front part of the two wheeled vehicle **101** is covered by a cowling **121** from the front side, the side, and the lower side thereof. Hereunder, the portion of the cowling **121** that covers the periphery of the head pipe **112** (the portion that faces the front side of the vehicle, and the portion that is fitted to this portion from the rear side) is referred to as a front cover **121**A.

A seat frame **116** extends diagonally upward and backward from the rear end part of each of the left and right main frames **113** and from each of the left and right pivot frames **114**. On each seat frame **116**, there is supported a seat **109** for the driver to sit thereon. The periphery of the seat frames **116** is covered by a seat cowling **122**. The vehicle frame **111** including the seat frames **116** is integrally formed with several types of metal members that are connected by means of welding and fastening. On the front side of the seat **109**, there is arranged a seat front cover **123** that protrudes upward from the upper edge of the left and the right main frames **113**. The seat front cover **123** is to be sandwiched by both of knees of a passenger (driver) that is seated on the seat **109**.

The main battery **102** comprises, for example, a plurality of (four in the figure) electrical batteries **102***a* lined up lengthwise, and these batteries are connected in series to generate a high voltage between 48V to 72V. Each electrical battery **102***a* is an energy storage that is capable of appropriately recharging/discharging, and it is composed of a lithium ion battery, a nickel hydride battery, a lead battery, or the like for example.

The main battery **102** is stationarily supported on the vehicle body frame **111** via a duct **141**, in a state with the lower part front side thereof fitted in between the left and right main frames **113**.

Immediately beneath the main battery **102**, there is positioned the motor unit **103**, and this motor unit **103** is stationarily supported on the vehicle body frame **111**. The motor unit **103** has a rotation axis line C1 along the left-right direction, and a driving shaft J of this motor unit **103** and the rear wheel **104** are linked only via a chain-type power transmission mechanism **104***a* for example. The power transmission mechanism **104***a* may be of a belt type or a shaft type.

The motor unit **103** performs variable speed driving by means of VVVF (variable voltage variable frequency) control for example, to drive the rear wheel **104** only via the power transmission mechanism **104***a*. However, the rear wheel **104** may be driven via a manual/automatic transmission and a clutch. Moreover, reference symbol **135** in the figure denotes a control unit that includes an ECU (electric control unit) and a PDU (power driver unit), which is a motor driver.

The duct **141** extends from the front end part to the rear end part of the vehicle body and is to supply outside air along the lengthwise direction, and it integrally has an electrical component housing part **142** that is formed so as to expand the flow passage at the lengthwise intermediate part thereof, an air inlet duct **143** that extends forward from the front end lower part of this electrical component housing part **142**, and an air exhaust duct **144** that extends backward from the rear end lower part of the electrical component housing part **142**.

The electrical component housing part **142** is positioned between the left and right main frames **113** and above the motor unit **103**, and the upper part thereof is fitted into the seat front cover **123**. The electrical component housing part **142** has a substantially horizontal plate-shaped bulkhead **145** that is stationarily provided on the lower part inner side thereof. The space above this bulkhead **145** serves as a battery housing part **146** for housing the main battery **102**, and the space below the bulkhead **145** serves as a driver housing part **147** for housing the control unit **135**.

While the tube-forming portion of the duct **141** is composed, for example, of a resin molded product, the bulkhead **145** is composed of a member that has comparatively high thermal conductivity such as aluminum alloy. The bulkhead **145** serves also as a heat sink of the main battery **102**, and the main battery **102** is mounted directly on this bulkhead **145**. In the bulkhead **145** there are formed a plurality of communication holes **148** that communicate between the respective housing parts **146** and **147**. The opening area of the communication holes **148** is made sufficiently smaller than the flow passage areas of the respective housing parts **146** and **147**.

At the front end part of the bulkhead **145** there is provided a front louver **138** that opens and closes an upper air inlet opening **146***a* at the front end of the battery housing part **146**. Meanwhile, at the rear end part of the lower wall of the electrical component housing part **142** there is provided a rear louver **139** that opens and closes a lower air exhaust opening **147***b* at the rear end of the driver housing part **147**. The respective louvers **138** and **139** are electrically operated, and operations thereof are controlled by the control unit **135** based on temperature information and so forth of the main battery **102**.

The air inlet duct **143** extends forward within the cowling **121** (front cover **121**A), and the front end opening thereof (air inlet opening **143***a*) opens toward the front side of the vehicle (outer side of the cowling), at the front end part of the cowling **121**. The air inlet opening **143***a* functions as a traveling airstream introduction opening when the vehicle is traveling.

The air inlet duct **143** branches to the left and right so as to avoid the vehicle body frame **111** (head pipe **112**), or it extends forward while being biased to either the left or right. The air inlet duct **143** intersects with the front fork **106** and the head pipe **112** when seen in the vehicle side view.

The air exhaust duct **144** extends backward within the seat cowling **122**, and the rear end opening thereof (air exhaust opening **144***a*) opens at the rear end part of the seat cowling **122**, toward the rear side of the vehicle. Within, for example, the base end part (front end part) of the air exhaust duct **144**, there is provided a fan **137** that force-supplies the air within the duct **141** from the air inlet opening **143***a* side to the air exhaust opening **144***a* side.

Each of the louvers **138** and **139** closes the upper air inlet opening **146***a* and closes the lower air exhaust opening **147***b* when the main battery **102** is at a low temperature (when the temperature of the main battery **102** is lower than a predetermined temperature that is suitable for recharging/discharging). Thereby, the outside air taken into the duct **141** first flows only into the driver housing part **147** to cool and remove heat from the control unit **135**, and then it flows into the battery housing part **146** through the respective communication holes **148**. It then flows around and heats the respective electrical batteries **102***a*, and then is discharged to the outside of the duct **141**.

On the other hand, the respective louvers **138** and **139** open the upper air inlet opening **146***a* and the lower air exhaust opening **147***b* when the main battery **102** is at a high temperature (when it is greater than or equal to the predetermined temperature). As a result, the outside air taken into the duct **141** flows respectively into the battery housing part **146** and the driver housing part **147** to cool the main battery **102** and the control unit **135** respectively, and then it is discharged to

the outside of the duct **141**. When the lower air exhaust opening **147***b* is opened, the rear louver **139** blocks the upper opening of the concaved part that houses the 12V sub battery **128**.

Here, the two wheeled vehicle **101** is provided with a vehicle approach alert device **140** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **160**, which is a sound emitter for emitting an alert sound, is arranged on the inner side of the front cover **121**A and below the lower end of the head pipe **112**, and it is attached on the inner surface side of the front cover **121**A for example. The speaker **160** is positioned approximately immediately above the front wheel **105** when seen in the side view (on the outer side of the outer circumferential part of the front fender **105***a*).

The sound emission direction of the speaker **160** (sound emission direction, shown with arrow **160***a* in the figure) is oriented diagonally downward and forward, and the sound thereof is directly emitted toward the outside of the front cover **121**A (toward the front side of the vehicle and in the traveling direction).

The sound emission direction **160***a* of the speaker **160** is approximately oriented to the traveling direction of the two wheeled vehicle **101**, and the sound of the speaker **160** can be recognized by pedestrians and other road users easily. On the other hand, the sound emission direction **160***a* is oriented to the direction of moving away from the head part H of the driver, and therefore, the magnitude of sound to be heard by the driver is suppressed. The sound volume of the speaker **160** is controlled by the control unit **161** above the air inlet duct **143** according to the vehicle speed and so forth. Electric power is supplied from the sub battery **128** to the speaker **160** and the control unit **161**.

The speaker **160** is positioned above the front wheel **105**. However, the area above the front wheel **105** is covered by the front fender **105***a*, and mud splash caused by the front wheel **105** is unlikely to come in contact with the speaker **160**, which is positioned on the back side thereof. There is no particular limitation to the number of speakers **160** to be installed.

The control unit **161** for output control of the speaker **160** is attached to the upper wall part of the rear part of the air inlet duct **143** (the portion at the rear of the head pipe **112** when seen in side view).

As has been described, as with the first embodiment, the vehicle approach alert device **140** for a saddle-ridden electric vehicle in the above embodiment is also such that the speaker **160** that outputs an alert sound is arranged within the front cover **121**A that covers the periphery of the head pipe **112** while the sound emission direction **160***a* thereof is oriented diagonally downward and forward, and therefore, it is possible to efficiently transmit an alert sound of the speaker **160** to the surrounding area while utilizing ground sound reflection. Moreover, with the speaker **160** being distanced from the driver and the sound emission direction **160***a* being oriented to the direction opposite to the driver, it is possible to reduce the magnitude of sound that is to emitted by the speaker **160** to be heard by the driver.

Furthermore, the vehicle approach alert device **140** is such that, with the speaker **160** being arranged below the head pipe **112**, the speaker **160** can be arranged distanced from the driver, and it is possible to reduce the magnitude of an alert sound to be heard by the driver and transmit the alert sound to the surrounding area efficiently, also utilizing ground sound reflection.

Moreover, the vehicle approach alert device **140** is such that with the speaker **160** being arranged on the outer circumferential side of the front fender **105***a* of the two wheeled vehicle **101**, it is possible, with use of the space below the head pipe **112**, which has a comparatively small number of components, to arrange the speaker **160** distanced from the driver, and with the speaker **160** being arranged at a position where mud splash and the like caused by the front wheel **105** are comparatively less likely, it is possible to make an advantageous arrangement for waterproofing the speaker **160**.

Moreover, the vehicle approach alert device **140** is such that on the head pipe **112**, there is steerably supported the front fork **106** that extends diagonally forward and downward and that suspends the front wheel **105**, and the speaker **160** is arranged in front of the front fork **106** when viewed from the side. Thereby, the speaker **160** can be arranged further distanced from the driver, and it is possible to reduce the magnitude of an alert sound to be heard by the driver.

Reference symbol **160'** in the figure denotes a speaker arranged at the lower end of the front cover **121**A, reference symbol **160***a'* denotes the sound emission of this speaker **160'**, reference symbol **121***b* denotes a protection wall (waterproofing wall) that is provided at the lower end of the front cover **121**A and immediately in front of the speaker **160'**, and reference symbol **121***c* denotes a tangent line of the tire that extends from the outer circumferential edge on the lower part rear side of the front wheel **105** and that passes through the upper end of the protection wall **121***b*. The sound emission direction **160***a'* of the speaker **160'** is oriented diagonally downward and forward, and the sound thereof is directly emitted toward the outside of the front cover **121**A (toward the front side of the vehicle and in the traveling direction).

The speaker **160'** is positioned at the rear of the protection wall **121***b* and below the tire tangent line **121***c* when viewed from the side. Moreover, in the front view (front side view) shown in FIG. **3**, the lower part of the speaker **160'** and the upper part of the protection wall **121***b* are overlapping with each other.

According to this configuration, in addition to the action and effect similar to those described above, it is possible to enable better use of ground sound reflection to efficiently transmit emitted sound of the speaker **160'** to the surrounding area, while keeping mud splash and the like to the speaker **160'** caused by the front wheel **105** at a comparatively low level with the protection wall **121***b*. Further, with the speaker **160'** being positioned further distanced from the driver, it is possible to further reduce the magnitude of sound that is emitted from the speaker **160'** to be heard by the driver. Moreover, by also providing the speaker **160** and having both of the respective speakers **160** and **160'** emit a sound together with an adjusted sound distribution, it is also possible to improve the efficiency of sound transmission to the surrounding area. As with the first embodiment, a sound emission duct may be provided for both or either one of the speakers **160** and **160'**.

<Third Embodiment>

Next, a third embodiment of the present invention is described, with reference to FIG. **4**.

A two wheeled vehicle **201** shown in FIG. **4** that serves as a saddle-ridden electric vehicle is a scooter type vehicle having a low floor **215**, that travels in a manner such that a rear wheel WR axially supported on an axle **223** is rotation-driven with rotation power exerted by an electric motor (power engine) M that is built into a swing arm **221**. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

A vehicle body frame **234** of the two wheeled vehicle **201** is provided with: a head pipe **236** that is tilted so the upper part thereof is positioned on the rear side; a main frame **235** that extends diagonally backward and downward from this head pipe **236**; a pair of left and right under frames **239** that each connects to the lower part of this main frame **235** via a bent part **238** and that extend backward; and a pair of left and right rear frames **240** that each integrally connects to the rear end of each under frame **239** and that extend diagonally backward and upward.

The head pipe **236** axially and turnably supports a steering stem **237**, and on the upper end of this steering stem **237**, there is fixed a steering handle bar **209**. On the other hand, on the lower end of the steering stem **237**, there is fixed an under bracket **268** that supports the upper end part of a front fork **202** with a pair of left and right portions. On the lower end part of each portion of the front fork **202**, there is axially supported a front wheel WF.

On the front part of each rear frame **240** of the vehicle body frame **234**, there is provided each of a pair of left and right pivot plates **219**. On each pivot plate **219** there is swingably borne via a pivot shaft **258**, the front part of the swing arm **221**. The swing arm **221** is of a cantilever type that uses an arm on the vehicle widthwise left side only to axially support the rear wheel WR. Between the rear part of the left side rear frame **240** and the rear part of the swing arm **221**, there is provided a rear cushion unit **231**. Within the swing arm **221**, in addition to the electric motor M, there are collectively arranged a centrifugal clutch and a deceleration mechanism (neither shown in the figure) serving as a mechanism for engaging/disengaging rotation driving force, and a PDU (power drive unit) **252** that controls output of the electric motor M.

The two-wheeled vehicle **201** is provided with: a front cover body **207** that covers the periphery of the head pipe **236** from the front side; a leg shield **210** that covers the periphery of the head pipe **236** from the rear side; the low floor **215** that continues to the lower rear side of the leg shield **210** and that covers a battery case **247** from the upper side so as to have the feet of a passenger sitting on a seat **224** placed thereon; a pair of left and right floor side covers **217** that extend perpendicularly downward from the outer side of the low floor **215** so as to cover the outer side of each under frame **239**; an under cover **218** that is provided to join the lower edges of the respective floor side covers **217**; a seat lower front part cover **216** that rises from the rear end of the low floor **215** so as to cover the space below the seat **224** from the front side; a pair of left and right side covers **225** that each continues to the outer rear side of the seat lower front part cover **216** so as to cover the space below the seat **224** from both sides; and a rear cover **228** that continues to the rear side of each side cover **225** so as to cover the rear wheel WR from the upper side.

The front cover body **207** that faces the vehicle body front side and the leg shield **210** that is fitted to this from the rear side, are integrally connected with each other, and they form a front cover **207**A that covers the vehicle body front part including the periphery of the head pipe **236**.

The battery case **247** houses a high voltage battery **248** of 48V to 72V for supplying electric power to the electric motor M.

To the front part of the battery case **247** there are connected, via connection tubes **246**, the downstream side end parts of left and right cooling air introduction ducts **245**. The respective cooling air introduction ducts **245** extend upward along the main frame **235** so as to sandwich, within the front cover **207**A, the main frame **235** from the outer sides, and then they are bent forward. Further, the each end opening thereof opens toward the front side within the front cover **207**A.

On the rear part upper surface of the battery case **247**, there is attached a cooling fan **253**, and with the operation of this cooling fan **253**, the air that has been introduced from the cooling air introduction duct **245** is introduced into the battery case **247** to cool the high voltage battery **248** within the battery case **247**.

Here, the two wheeled vehicle **201** is provided with a vehicle approach alert device **250** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **251**, which is a sound emitter for emitting an alert sound, is arranged on the inner side of the front cover **207**A, above the upper end of the head pipe **236**, and on the side of the steering stem **237**, and it is attached on the head pipe **236** via a stay or the like.

The sound emission direction of the speaker **251** (sound emission direction, shown with arrow E) is oriented diagonally downward and forward, and at the portion of the front cover **207**A positioned in the sound emission direction, there is appropriately formed an opening **251***b* for emitting a sound of the speaker to the outer side of the front cover **207**A (to the vehicle front side, and in the traveling direction).

As a result, the sound emission direction of the speaker is substantially oriented to the traveling direction of the two wheeled vehicle, and the sound of the speaker is likely to be recognized by pedestrians and other road users. Further, with the sound emission direction being oriented in the direction of moving away from the head part of the driver (not shown in the figure), the magnitude of the speaker sound to be heard by the driver can be suppressed. There is no particular limitation to the number of the speakers **251** and the openings **251***b* to be installed.

Below the seat **224**, there is arranged a goods storage box **249** that can be opened or closed by this seat **224**, and at the bottom part of this goods storage box **249**, there is arranged a control unit **260** for output control of a 12V low voltage battery **255** and the speaker **251**. The sound volume of the speaker is controlled by this control unit **260** according to the vehicle speed and so forth.

As has been described, as with the first embodiment, the vehicle approach alert device **250** for a saddle-ridden electric vehicle in the above embodiment is also such that the speaker **251** that outputs an alert sound is arranged within the front cover **207**A that covers the periphery of the head pipe **236** while the sound emission direction **251***a* thereof is oriented diagonally downward and forward, and therefore, it is possible to efficiently transmit an alert sound of the speaker **251** to the surrounding area while utilizing ground sound reflection. Moreover, with the speaker **251** being distanced from the driver and the sound emission direction **251***a* being oriented to the direction opposite to the driver, it is possible to reduce the magnitude of sound that is to emitted by the speaker **251** to be heard by the driver. Further, as with the first embodiment, a sound emission duct **251***c* may be provided between the speaker **251** and the opening **251***b*.

<Fourth Embodiment>

Next, a fourth embodiment of the present invention is described, with reference to FIG. **5**.

A three wheeled vehicle **301** shown in FIG. **5** that serves as a saddle-ridden electric vehicle is provided with a roofed cabin **304** that has a wind screen **302** at the front part thereof, and a low floor **303** at the bottom part thereof. The cabin **304** is supported on a front vehicle body FB that is provided with a single front wheel (steering wheel) **307**, and this vehicle

front body FB is left-right-swingably (rollably) connected to a rear vehicle body RB that is provided with a pair of left and right rear wheels (driving wheels) **308**. That is to say, the three wheeled vehicle **301** is formed as a swing type vehicle in which the front and rear vehicle bodies FB and RB can swing relatively to each other.

A vehicle body frame **305** that forms the framework of the front vehicle body FB is such that the front end part thereof has a head pipe **312** that is inclined with respect to the perpendicular direction provided thereon, and into this head pipe **312**, there is turnably inserted a steering stem **314**. To the lower end part of the steering stem **314**, there is integrally connected the upper end part of a front fork **313** with a pair of left and right portions. At the upper end of the steering stem **314**, there is integrally attached a steering handle bar **315**.

A pair of left and right trailing arms **313***a* extend diagonally downward and backward respectively from the lower end of each of the left and right portions of the front fork **313**, and the front wheel **307** is axially supported on the end part of these left and right trailing arms **313***a*. Between the left and right trailing arms **313***a* and the left and right portions of the front fork **313**, there are intervened a pair of left and right cushion units **313***b*. A front fender **307***a* is attached on the left and right portions of the front fork **313**.

The vehicle body frame **305** has: a single front part frame (vehicle body frame member) **305***f* that extends diagonally backward and downward from the lower part rear side of the head pipe **312**; a pair of left and right lower part frames **305***b* that branch to the left and right from the lower end of the front part frame **305***f* and that extend backward along the low floor **303** while being maintained parallel to each other; a pair of left and right rear part frames **305***r* that are bent and extend diagonally backward and upward from the rear end of the left and right lower part frames **305***b*; and a pair of left and right carrier frames **305***n* that are bent and extend diagonally upward and backward from the rear end of the left and right rear part frames **305**.

To the rear part of the left and right lower part frames **305***b* there is connected, via a link member **316**, the front end part of a swing joint **317** that swingably connects the rear vehicle body RB. The link member **316** projects downward of the left and right lower part frames **305***b*, and it is allowed to swing forward and backward by a predetermined angle. On the lower end of this link member **316**, there is vertically swingably supported, via a swing shaft S along the vehicle widthwise direction, the front end part of the swing joint **317** that extends lengthwise.

The swing joint **317** is provided with a joint case **318** with the front end thereof supported on the link member **316**, and a joint shaft **319** that is inserted in and supported on the rear end side of this joint case **318** while being allowed to turn about the axial line R that is angled diagonally backward and downward.

The joint shaft **319** is connected, via a hanger plate **320**, to the lower part front side of a power unit **309** that is a prime mover of the three wheeled vehicle **301**. The power unit **309** and the left and right rear wheels **308** supported on both sides thereof collectively form the rear vehicle body RB. That is to say, the front and rear vehicle bodies FB and RB are connected so as to be able to relatively swing about the axial line R via the swing joint **317**.

To the upper part of the joint case **318**, there is connected the lower end of a rear cushion **321**, and the upper end of this rear cushion **321** is connected to the left and right rear part frames **305***r*. As a result, there is formed a rear suspension that vertically swings the swing joint **317** and the rear vehicle body RB with respect to the front vehicle body FB.

A vehicle cover provided for the front vehicle body FB has: a front cover body **324** that covers the periphery of the head pipe **312** from the front side; a front inner cover **325** that covers the periphery of the head pipe **312** from the rear side; the low floor **303** that covers the periphery of the left and right lower part frames **305***b*; a rear part cover **326** that covers the periphery of the left and right rear part frames **305***r*; and a carrier **327** that covers the periphery of the left and right carrier frames **305***n*.

The front cover body **324** and the front inner cover **325** are fitted with each other in the lengthwise direction to thereby form a front cover **324**A that covers the vehicle body front part including the periphery of the head pipe **312**. The front cover **324**A is provided in a range that spans from the lower end of the wind screen **302** to the front end of the low floor **303**, and it forms the front part lower side of the cabin **304**. The upper part of the cabin **304** is formed with the wind screen **302**, a roof **302***a*, and a roof rear supporting part **302***b*. The lower part of the cabin **304** is formed with the low floor **303** and the rear part cover **326**. On the rear end of the rear part cover **326** there is provided, in a standing condition, a carrier front wall part **328** that continues to the lower side of the roof rear supporting part **302***b*.

Inside the cabin **304** and in front of the carrier **327**, there is arranged a seat **329** for a passenger to sit thereon, and this seat **329** is supported on the seat lower cover **329***a* that is provided so as to protrude from the rear part cover **326** to the inner side of the cabin **304**.

The carrier **327** and the carrier frames **305***n*, via a hinge shaft **327***a* along the vehicle width direction that is provided on the base part side (front end side) thereof, are turnably connected to the rear part cover **326** and the rear part frames **305***r*. As a result, the carrier **327** and the carrier frames **305***n* can turn between the usage state where it is arranged substantially horizontally, and the storage state where it stands up substantially vertically. With these carrier **327** and the carrier frames **305***n* being in the storage state, it becomes easy to perform maintenance work on the power unit **309** positioned below them. Reference symbol **327***b* in the figure denotes a goods storage box that can be attached on the carrier **327**.

The power unit **309** is provided with a motor unit **330** that supports an axle **334** of the left and right rear wheels **308**, and a battery unit **331** that is arranged and fixed on the upper part of the motor unit **330**.

The motor unit **330** has an electric motor (power engine) **332** for traveling that drives the left and right rear wheels **308**, and a differential mechanism (not shown in the figure) that engages with the electric motor **332** via a counter gear **336**, and these are housed within a motor case **333**. On the lower part front side of the motor case **333**, there is fixed the hanger plate **320**.

The battery unit **331** is provided with a battery case **350** that integrally continues to the motor case **333**, and, for example, a lithium ion type battery **351** housed within this battery case **350**.

The battery **351** is formed separately, for example, as a pair of front and rear upper batteries **352** positioned above the axle **334** of the left and right rear wheels **308**, and a lower battery **353** that is dropped into the space between the left and right rear wheels **308** and in front (or at rear) of the axle **334**. With these respective batteries **352** and **353** being connected in series, a high voltage of 48V to 72V is generated.

An upper lid body **358** of the battery case **350** is such that at the front part thereof, there is provided an air inlet duct **370**, and on the upper rear side, there is provided an air exhaust duct **372** having a built-in cooling fan. The outside air that has been introduced from the air inlet duct **370** into the case flows

around and cools the battery **351**, and then it is discharged to the outside of the case from the air exhaust duct **372**.

On both sides of the battery case **350** there are integrally provided left and right rear fenders **366** that cover the upper outer circumferences of the left and right rear wheels **308**.

At the rear end part of the low floor **303** and on the inner side of the lower end part of the seat lower cover **329***a*, there is housed a 12V sub battery **377** that supplies electric power to 12V auxiliary devices and control devices.

On the front wall outer surface of the battery case **350** there is attached a DC-DC converter **394** that lowers the voltage of the battery **351** and recharges the sub battery **377**. On the front surface of the DC-DC converter **394** there is provided a vertical heat release fin **395**.

On the inner side of the battery case **350** and in front of the upper batteries **352**, there are housed a contactor **396** that switches the driving circuit of the electric motor **332** ON and OFF, and a battery managing unit (BMU) **397** that is arranged below this contactor **396** and that performs recharge and discharge control of the battery **351**.

The control unit **398** that is arranged on the front wall outer surface of the motor case **333** and below the DC-DC converter **394** integrally has: a power drive unit (PDU) that serves as a switching unit (driver) for driving the electric motor **332**; and an ECU that controls the battery managing unit **397** and the power drive unit (neither shown in the figure).

The ECU receives inputs of accelerator throttle open signals from an accelerator grip provided on the steering handle bar **315**, and the battery managing unit **397** and the power drive unit are controlled based on these accelerator throttle open signals. The ECU receives not only accelerator throttle open signals but also signals from various sensors, and it outputs control signals of various auxiliary devices.

Electric power output from the battery **351** is supplied to the power drive unit via the contactor **396** that operates in synchronization with a main switch (not shown in the figure), and after being converted from a direct current to a three-phase alternating current in this power drive unit, it is supplied to the electric motor **332**, which is a three-phase alternating current motor. Moreover, electric power output from the battery **351** has its voltage lowered via the DC-DC converter **394**, and is supplied also to the sub battery **377**.

The recharging/discharging status and the temperature of the battery **351** are monitored by the battery managing unit **397**, and this information is shared with the ECU. The ECU receives, in addition to accelerator throttle open signals, inputs of signal information from various types of sensors, and the ECU performs drive control of the electric motor **332** via the power drive unit, based on this information. The battery **351** can be recharged by supplying electric power from an external power supply for example. An inverter may be separately provided when recharging the battery **351** from an AC 100V commercial power supply.

Here, the three wheeled vehicle **301** is provided with a vehicle approach alert device **340** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **341**, which is a sound emitter for emitting an alert sound, is arranged on the inner side of the front cover **324**A and below the lower end of the head pipe **312**, and it is attached on the front side of the front part frame **305***f*. The speaker **341** is arranged within the space having a triangular shape with the front fork **313** and the cushion, and the front part frame **305***f* being the upper two edges thereof when viewed from a side.

The sound emission direction of the speaker **341** (sound emission direction, shown with arrow **341***a* in the figure) is oriented diagonally downward and forward, and in this sound emission direction **341***a* (diagonally downward and forward of the speaker **341**), there is provided a bell-bottom-shaped sound emission duct **342** that extends diagonally downward and forward while tapering outward, along the sound emission direction **341***a*. The end part of the sound emission duct **342** opens to the outside of the front cover **324**A, and it gives a directionality to sound to be emitted from the speaker **341** and emits the sound diagonally downward and forward of the front cover **324**A.

The sound emission direction **341***a* of the speaker **341** is approximately oriented to the traveling direction of the three wheeled vehicle **301**, and the sound of the speaker **341** can be recognized by pedestrians and other road users easily. On the other hand, the sound emission direction **341***a* is oriented to the direction of moving away from the head part (not shown in the figure) of the driver, and therefore, the magnitude of the sound of the speaker **341** to be heard by the driver is suppressed. The sound volume of the speaker **341** is controlled by the control unit **398** according to the vehicle speed and so forth.

The speaker **341** and the sound emission duct **342** are positioned diagonally upward and backward of the front wheel **307**. However, the area diagonally upward and the backward of the front wheel **307** is covered by the front fender **307***a*, and therefore, rain water and so forth splashed by the front wheel **307** are unlikely to come in contact with the speaker **341** and the sound emission duct **342** positioned on the back side thereof. There is no particular limitation to the number of speakers **341** to be installed.

As has been described, as with the first embodiment, the vehicle approach alert device **340** for a saddle-ridden electric vehicle in the above embodiment is also such that the speaker **341** that outputs an alert sound is arranged within the front cover **324**A that covers the periphery of the head pipe **312** while the sound emission direction **341***a* thereof is oriented diagonally downward and forward, and therefore, it is possible to efficiently transmit an alert sound of the speaker **341** to the surrounding area while utilizing ground sound reflection. Furthermore, with the speaker **341** being distanced from the driver and the sound emission direction **341***a* being oriented to the direction opposite to the driver, it is possible to reduce the magnitude of sound that is to emitted by the speaker **341** to be heard by the driver.

Moreover, the vehicle approach alert device **340** is provided with the sound emission duct **342** that extends diagonally downward and forward from the speaker **341** along the sound emission direction **341***a*. The speaker **341** is attached, within the front cover **324**A, on the vehicle body frame **305**, and it emits a sound to the outside of the front cover **324**A through the sound emission duct **342**. As a result, while the speaker **341** is arranged within the front cover **324**A, an alert sound can be efficiently emitted with a directionality to the outside of the front cover **324**A from the sound emission duct **342**, and it is possible to increase the level of alerting effect and reduce the magnitude of the alert sound to be heard by the driver.

Furthermore, the vehicle approach alert device **340** is such that, with the speaker **341** being arranged below the head pipe **312**, the speaker **341** can be arranged distanced from the driver, and it is possible to reduce the magnitude of an alert sound to be heard by the driver and transmit the alert sound to the surrounding area efficiently, also utilizing ground sound reflection.

Moreover, the vehicle approach alert device **340** is such that with the speaker **341** being arranged on the outer circumferential side of the front fender **307***a* of the three wheeled vehicle **301**, it is possible, with use of the space below the head pipe **312**, which has a comparatively small number of components, to arrange the speaker **341** distanced from the driver, and with the speaker **341** being arranged at a position where mud splash and the like caused by the front wheel **307** are comparatively less likely, it is possible to make an advantageous arrangement for waterproofing the speaker **341**.

The vehicle approach alert device **340** is provided with the front part frame **305***f* that extends diagonally backward and downward from the head pipe **312**. On the head pipe **312** there is steerably supported the front fork **313** that extends diagonally forward and downward and that suspends the front wheel **307**, and the speaker **341** is arranged in front of the front part frame **305***f* and at the rear of the front fork **313** when seen in side view. As a result, the speaker **341** is arranged below the head pipe **312**, within the space having a triangular shape in side view with the vehicle body frame member and the front fork **313** serving as the two edges thereof, and therefore, it is possible to efficiently arrange the speaker **341** below the head pipe **312** and easily achieve protection of the speaker **341**.

Reference symbol **341'** in the figure denotes a speaker arranged on the front end part of the power unit **309**, and reference symbol **341***a'* denotes a sound emission direction of this speaker **341'**. At the front end part of the power unit **309**, there is provided an extended cover **358***a* that integrally continues to the front side of the battery case **350** and the motor case **333**, and within this extended cover **358***a*, there are housed the DC-DC converter **394**, the control unit **398**, and the speaker **341'**.

The sound emission direction **341***a'* of the speaker **341'** is oriented diagonally downward and forward, and sound emission is performed from the lower part opening of the extended cover **358***a*, which opens downward, toward the ground. As a result, it is possible to efficiently transmit a sound of the speaker **341'** to the surrounding area while using ground sound reflection, and with the speaker **341'** being distanced from the driver, the magnitude of the alert sound to be heard by the driver can be reduced.

Hereunder, there is described a frequency control of an alert sound of the speaker in each embodiment.

FIG. **6** is a graph showing the relationship between the rotation speed rpm of the electric motor and the frequency Hz of the alert sound of the speaker in the case where the power transmission path from the electric motor to the rear wheel has a centrifugal clutch.

In each embodiment, the alert sound is output as a synthetic sound of four frequencies (including consonant sound and dissonant sound). To describe in detail, the alert sound has a first sound serving as a reference sound, a second sound having a frequency 1.18 times the reference sound, a third sound having a frequency 1.23 times the reference sound, and a fourth sound having a frequency 1.33 times the reference sound. The respective sounds are output at the following percentages. The first sound is output at 30% of the entire sound, the second sound is output at 25% of the entire sound, the third sound is output at 25% of the entire sound, and the fourth sound is output at 5% of the entire sound. The remaining 15% is a noise sound.

In FIG. **6**, the slope of the first sound is 48 Hz/1,000 rpm, and has an intercept of 288 Hz at 1,000 rpm.

That is to say, the frequency of the first sound at 1,000 rpm can be obtained from the following formula (1).

$$1{,}000\times 48/1{,}000+288=336\ (\mathrm{Hz}) \tag{1}$$

At this time, the frequency of the second sound is 396 Hz, the frequency of the third sound is 413 Hz, and the frequency of the fourth sound is 447 Hz, and a synthetic sound that contains these respective sounds is output from the speaker **160**. A synthetic sound is used as an alert sound in order to make the alert sound more audible to the surrounding area compared to a single sound at a specific frequency. An alert sound of a single sound may be output.

The alert sound is output when the rotation speed of the electric motor is in a range of 1,000 to 4,400 rpm. 1,000 rpm of the electric motor corresponds to the engagement rotation speed of the centrifugal clutch, that is, the take-off rotation speed, and 4,400 rpm corresponds to the rotation speed at which no alert sound is required.

The alert sound shifts to a higher frequency [in proportion to] with the increase of the motor rotation speed. This is done in order for the state of acceleration and deceleration of the vehicle to be comprehended.

Moreover, by making the increase rate of the alert sound frequency lower than the increase rate of the motor rotation speed, the fluctuation band of the alert sound frequency is suppressed, and even the highest frequency is lower than the specific frequency (800 Hz).As a result, it is possible to make the sound more audible to people of any age group, and the alert sound can be set to a favorable sound range. The lowest frequency of the alert sound is preferably higher than 100 Hz, taking the audibility into consideration.

That is to say, by setting the sound emission frequency of the speaker to a range between 100 HZ and 800 HZ, it is possible to emit the alert sound with use of an audible sound range.

Here, if the ratios of the frequencies of the second sound, the third sound, and fourth sound with respect to the frequency of the first sound (reference sound) are a2, a3, and a4, these ratios have a relationship shown with the following formula (2).

$$a2-1>a3-a2 \tag{2}$$

It has been discovered that an alert sound can be made a favorable sound with fluctuations or undulations, by making the "a3−a2" less than or equal to 0.05.

As shown in FIG. **7**, the alert sound is set such that it is output at a constant sound volume from the vehicle take-off rotation speed X1 (1,000 rpm in the respective embodiments), however, the sound volume starts to decrease parabolically from the ease-off rotation speed X2 around the halfway (2,000 rpm in the respective embodiments), and the output stops at the sound stop rotation speed X3 (4,400 rpm in the respective embodiments).

As shown in FIG. **8**, the frequency of the alert sound, instead of the rotation speed of the electric motor, may be controlled according to the changes in the vehicle speed. In this case, an alert sound may be emitted at the point in time where the rotation of the wheel from the stop state (vehicle speed 0 km/h) is detected for example.

FIG. **9** is a block diagram showing a configuration of the control unit for the speaker. The control unit includes an REG (regulator) circuit **270**, an EEPROM **271** serving as a pseudo engine sound volume memory device that records a sound source and a sound volume of an engine sound of an internal combustion engine vehicle, a WDT (watch dog timer) **272** for maintaining the normal system operation, an audio processor **275**, and an amplifier **276**.

The control unit receives an input of information from the PDU (motor driver) via a first coupler **277**. Moreover, to the REG circuit **270** of the control unit there is connected via a two-pin type second coupler **279**, a sub battery that serves as a speaker power supply. Furthermore, to the amplifier **276** of the control unit there is connected via the second coupler **279**,

a speaker. The audio processor **275** receives inputs of output information from the EEPROM **271** and the WDT **272**, and motor rotation speeds Nm and vehicle speeds V input from the PDU.

Based on the information of the motor rotation speed Nm and the vehicle speed V, the audio processor **275** calls a predetermined sound source from the EEPROM **271**, and outputs an alert sound from the speaker at a predetermined sound volume via the amplifier **276**.

In this figure, the input portion of the sub battery and the output portion from the amplifier **276** are illustrated as being separated, however, both of these portions are consolidated at a four-pin type second coupler **279**. Moreover, output information of a rain drop sensor **273** and an illumination sensor **274** may be further input to the audio processor **275**. In this case, for example, this may be handled by replacing the four-pin type second coupler **279** with a six-pin type coupler.

In the case where the climate is detected as being raining by the rain drop sensor **273**, the audio processor **275** may increase the sound volume of the alert sound compared to that at normal times so that the recognition effect of the alert sound would not be reduced by the sound of falling rain. Moreover, when the time is detected as being night time by the illumination sensor **274**, the alert sound volume may be set to be lower than that at normal times. Furthermore, by applying a noise sensor or the like, it is also possible to set the alert sound volume to be increased when, for example, the noise level of the surrounding area is high due to increased traffic.

FIG. **10** is a flow chart showing steps of an approach alert sound output control. In step S**1**, a motor rotation speed Nm is detected based on the information from the PDU, and in step S**2**, a vehicle speed V is detected based on the information from the PDU. In step S**3**, it is determined whether or not the motor rotation speed is less than or equal to an upper limit value NL. This upper limit value NL is set to the engagement rotation speed of the centrifugal clutch that is arranged on the output transmission path of the electric motor.

In step S**4**, an alert sound is output from the speaker, the sound volume of which increases according to the increase in the motor rotation speed Nm. In step S**5**, it is determined whether or not the motor rotation sped Nm has exceeded the upper limit value NL. If a positive determination is made the process proceeds to step S**6**, and if a negative determination is made the process returns to step S**4**. That is to say, while the non-traveling state is maintained until the centrifugal clutch is engaged, the alert sound is output so that the sound volume thereof increases according to the rotation speed of the electric motor.

In step S**6**, it is determined whether or not the vehicle speed V is less than or equal to an upper limit value VL. In the respective embodiments, this upper limit value VL is set to a vehicle speed of 20 km/h. If a positive determination is made in step S**6**, the process proceeds to step S**7**, and the alert sound is output so as to fill in the difference from the target sound volume according to the increase in the vehicle speed V. In the respective embodiments, the alert sound is output so as to fill in the sound volume difference between a two wheeled vehicle with an electric motor and a two wheeled vehicle with an internal combustion engine.

The alert sound volume at respective predetermined vehicle speeds may be preliminarily set as sound volume data by means of experiment or the like to suit each vehicle, and the set data may be stored in the EEPROM **271** of the control unit. In the respective embodiments, it is set to output a traveling sound equivalent to that of a Japanese class 1 motorcycle with a 50 cc engine that corresponds to the vehicle class of each vehicle. However, if the vehicle class of each vehicle corresponds to that of a Japanese ordinary motorcycle for example, a traveling sound equivalent to that of a Japanese ordinary motorcycle class vehicle with a 400 cc engine may be output. The relationship between the vehicle class of each vehicle and the alert sound volume may be arbitrarily set in accordance with vehicle classifications and license classifications set out in road traffic law.

In step S**8**, it is determined whether or not the vehicle speed V has exceeded the upper limit value VL, and if a positive determination is made, the process proceeds to step S**9** to stop the output of the alert sound, and the sequence of control ends. If a negative determination is made in step S**6**, the process proceeds to step S**9**, and if a negative determination is made in step S**8**, the process returns to step S**7**.

According to the approach alert sound output control described above, it is possible to output an approach alert sound at a sound volume that accords with the traveling sound of an actual internal combustion engine vehicle, compared to the control method that simply increases the sound volume based on the increase in the motor rotation speed and the vehicle speed. Specifically, it is possible to perform a control in a manner such that a traveling sound equivalent to that of an internal combustion engine vehicle corresponding to the vehicle class or vehicle classification of each vehicle is output. Furthermore, the tone of the approach alert sound may be selected from various types of tones, in addition to recorded data from an internal combustion engine vehicle corresponding to the vehicle class or vehicle classification of each vehicle.

Moreover, the sound emitter is such that by raising the frequency of the alert sound [in proportion to] with the increase in the rotation speed of the electric motor, the state of acceleration and/or deceleration of the vehicle can be comprehended by pedestrians and other road users, and it is possible, in combination with the arrangement of the sound emitter, to obtain a high level of alerting effect even with a small sound emitter.

Furthermore, by setting the increase rate of the alert sound frequency to become lower than the increase rate of the electric motor rotation speed, it is possible to make the surroundings recognize acceleration of the vehicle while setting the alert sound at a favorable tone range that also has a high level of alerting effect.

In addition, with the sound emission frequency of the sound emitter being set within a range between 100 HZ and 800 HZ, it is possible, in combination with the arrangement of the sound emitter, to emit a sound that can be easily heard by and is favorable to people of any age group, using a small sound emitter.

<Fifth Embodiment>

A fifth embodiment of the present embodiment is described, with reference to FIG. **11**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A three wheeled vehicle **1301** shown in FIG. **11** that serves as a saddle-ridden electric vehicle is provided with a roofed cabin **1304** that has a wind screen **1302** at the front part thereof, and a low floor **1303** at the bottom part thereof. The cabin **1304** is supported on a front vehicle body FB that is provided with a single front wheel (steering wheel) **1307**, and this vehicle front body FB is left-right-swingably (rollably) connected to a rear vehicle body RB that is provided with a pair of left and right rear wheels (driving wheels) **1308**. That is to say, the three wheeled vehicle **1301** is formed as a swing type vehicle in which the front and rear vehicle bodies FB and RB can swing relatively to each other.

Here, the three wheeled vehicle **1301** is provided with a vehicle approach alert device **1340** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **1341** that serves as a sound emitter for emitting an alert sound, is provided below a driver's seat part (upper surface of a seat **1329**) and on the front end side (base end side) of a power unit **1309**.

At the front end part of the power unit **1309**, there is provided an extended cover (unit cover) **1358***a* that integrally continues to the front side of a battery case **1350** and a motor case **1333**, and within this extended cover **1358***a*, there are housed a DC-DC converter **1394**, a control unit **1398**, and a speaker **1341**.

The sound emission direction (sound emission direction, shown with arrow **1341***a* in the figure) of the speaker **1341** is oriented diagonally downward and forward, and sound emission is performed from the lower part opening of the extended cover **1358***a*, which opens downward, toward the ground. As a result, it is possible to efficiently transmit a sound of the speaker **1341** to the surrounding area while using ground sound reflection, and with the speaker **1341** being distanced from the driver, the magnitude of the alert sound to be heard by the driver can be reduced. Moreover, a swing joint **1317** is positioned below the speaker **1341**, and it is also possible to suppress splash and the like from the road surface against the speaker **1341**.

The sound volume of the speaker **1341** is controlled by the control unit **1398** according to the vehicle speed and so forth. There is no particular limitation to the number of speakers **1341** to be installed.

As has been described, the vehicle approach alert device **1340** for a saddle-ridden electric vehicle in the above embodiment is such that an alert sound for notifying the surrounding area of approach of the three wheeled vehicle **1301**, is output to the surrounding area from the speaker **1341** attached on the vehicle body of the three wheeled vehicle **1301** that includes the electric motor **1332** in the power engine (power unit **1309**). Further, there is provided the power unit **1309** that supports the electric motor **1332** and the driving wheels (rear wheels **1308**) and that is vertically swingably connected to the vehicle body frame **1305**, and the speaker **1341** is provided on the power unit **1309**, below the driver's seat part (seat **1329**).

According to this configuration, by arranging the speaker **1341** below the driver's seat part and on the power unit **1309**, which is comparatively close to the ground, it is possible to reduce the magnitude of an alert sound to be heard by the driver due to the speaker **1341** being distanced therefrom, and transmit the alert sound efficiently to the surrounding area using ground sound reflection also.

Moreover, the vehicle approach alert device **1340** is provided with the extended cover **1358***a* that covers the front part of the power unit **1309**, and the speaker **1341** is arranged within the extended cover **1358***a*.

According to this configuration, sound emission of the speaker **1341** can be diffused within the extended cover **1358***a* to efficiently transmit this sound to the surrounding area, and the speaker **1341** can be protected easily. Furthermore, it is also possible to further reduce the magnitude of an alert sound to be heard by the driver.

Moreover, the vehicle approach alert device **1340** is such that the sound emission direction **1341***a* of the speaker **1341** is oriented downward.

According to this configuration, an alert sound can be efficiently transmitted to the surrounding area using ground sound reflection, and it is possible to further reduce the magnitude of the alert sound to be heard by the driver.

Furthermore, the vehicle approach alert device **1340** is such that the three wheeled vehicle **1301** is of a swing type vehicle that swings the vehicle body frame **1305** to the left and right with respect to the power unit **1309** having the pair of left and right driving wheels (rear wheels **1308**), and the speaker **1341** is arranged above the swing joint **1317** that connects the power unit **1309** and the vehicle body frame **1305**.

According to this configuration, it is possible, with the comparatively strong swing joint **1317**, to suppress mud splash made to the speaker **1341** from the road surface.

Moreover, the vehicle approach alert device **1340** is provided with the battery **1351** between the pair of left and right driving wheels (rear wheels **1308**), and the speaker **1341** is arranged in front of the battery **1351**.

According to this configuration, the mass of the power unit **1309** can be concentrated, and the wiring arrangement can be established easily when connecting the battery **1351** to the electric motor **1332**. Moreover, by arranging the speaker **1341** in front of the battery **1332**, the sound reflection effect of the battery **1351** with mass can give an alert sound a forward directionality, while efficiently diffusing the alert sound within the power unit **1309**.

<Sixth Embodiment>

Next, a sixth embodiment of the present invention is described, with reference to FIG. **12**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A two wheeled vehicle **1201** shown in FIG. **12** that serves as a saddle-ridden electric vehicle is a scooter type vehicle provided with: a step floor **1204** that is provided between the steering handle bar **1202** and a seat **1203** for a passenger to sit thereon and that serves as a low floor part for passenger's feet to be placed thereon; and a vehicle cover **1205** that covers substantially the entire vehicle body, and has a single front wheel **1214** serving as a steering wheel and a single rear wheel **1207** serving as a driving wheel. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

At a rear position on the step floor **1204**, there is mounted a battery unit **1206**, and electric power of this battery unit **1206** is supplied to an electric motor **1208** on the left side of the rear wheel **1207** to drive this electric motor **1208**. Further, with this driving force, the rear wheel **1207** is driven to allow the two wheeled vehicle **1201** to travel.

A vehicle body frame **1211** of the two wheeled vehicle **1201** is formed by integrally joining several types of steel materials by means of welding or the like. On the front end part of the vehicle body frame **1211** there is provided a head pipe **1212** that steerably supports a front wheel suspension system. On the lower part rear side of the vehicle body frame body **1211** there is provided a pivot bracket **1213***a* that vertically swingably supports a rear wheel suspension system.

The rear wheel suspension system is provided with a swing arm **1218** that axially supports the rear wheel **1207** on the rear end part thereof. The swing arm **1218** forms a swing unit (power engine, driving unit) **1218**U that includes the electric motor **1208** and a gear mechanism (deceleration mechanism) **1219** built into the rear end part of the left arm thereof.

The front end part of the swing unit **1218**U is vertically swingably supported on the pivot bracket **1213***a* of the vehicle body frame **1211** via a pivot shaft **1213**. The rear end part of the swing unit **1218**U is elastically supported on the upper part rear side of the vehicle body frame **1211** via a cushion unit **1221**. The outer side of the swing unit **1218**U is covered by a unit cover **1218***a*.

Here, the two wheeled vehicle **1201** is provided with a vehicle approach alert device **1240** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **1241** that serves as a sound emitter for emitting an alert sound is provided below a driver' seat part (upper surface of a seat **1203**) and on the front end side (base end side) of the swing unit **1218**U, and it is housed within the front part of the unit cover **1218***a*.

The sound emission direction of the speaker **1241** (sound emission direction, shown with arrow **1241***a* in the figure) is oriented diagonally downward and forward, and sound emission is made toward the ground through the spacing between the swing unit **1218**U, the vehicle body frame **1211**, and the battery unit **1206**. The front end part of the swing unit **1218**U is positioned below the speaker **1241**, and it is also possible to suppress splash and the like from the road surface against the speaker **1241**.

As has been described above, also in the vehicle approach alert device **1240** for a saddle-ridden electric vehicle in the above embodiment, by arranging the speaker **1241** below the driver's seat part and on the swing unit **1218**U, which is comparatively close to the ground, it is possible to reduce the magnitude of an alert sound to be heard by the driver due to the speaker **1241** being distanced therefrom, and transmit the alert sound efficiently to the surrounding area using ground sound reflection also.

Moreover, sound emission of the speaker **1241** can be diffused within the unit cover **1218***a* to efficiently transmit this sound to the surrounding area, and the speaker **1241** can be protected easily.

Furthermore, an alert sound can be efficiently transmitted to the surrounding area using ground sound reflection, and it is possible to further reduce the magnitude of the alert sound to be heard by the driver.

<Seventh Embodiment>

A seventh embodiment of the present embodiment is described, with reference to FIG. **13**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A two wheeled vehicle **2010** shown in FIG. **13** that serves as a saddle-ridden electric vehicle is such that: at the center part of the vehicle body thereof, there are mounted a main battery **2091** for traveling and a power unit assembly (power engine) **2050**; the power unit assembly **2050** is driven with electric power supplied from the main battery **2091**; and the driving force is transmitted to the a rear wheel **2031**, which is a driving wheel, for traveling. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

Into a head pipe **2012** at the front end of the vehicle body frame **2011**, there is rotatably inserted a steering stem **2014**. At the lower end of the steering stem **2014**, there is fixed a bottom bridge **2014***a*, and at the upper end, there is fixed a top bridge **2014***b*. On both of the left and right sides of the respective bridges **2014***a* and **2014***b*, there are attached the upper part of a front fork **2015** with a pair of left and right portions. On the lower end part of the left and right portions of the front fork **2015**, there is axially supported a front wheel **2016**. At the upper part of the top bridge **2014***b*, there is attached a steering handle bar **2017**.

In front of the head pipe **2012**, there is arranged a single-lamp type circular head lamp (electrical component) **2018**, and this head lamp **2018** is supported on the respective bridges **2014***a* and **2014***b* via a lamp stay **2018***a* that joins these bridges. Moreover, above the head lamp **2018**, there is arranged a meter unit (electrical component) **2019**, and this meter unit **2019** is supported on the top bridge **2014***b* via a meter stay **2019***a*.

The vehicle body frame **2011** has: a single main frame **2022** that includes an upper frame part **2020** extending backward from the head pipe **2012** and a back frame part **2021** extending downward from the rear end of this upper frame part **2020**, and that is arranged at the vehicle widthwise center; a single down tube **2026** that includes a front frame part **2024** extending downward from the lower side of the main frame **2022** of the head pipe **2012**, and a lower frame part **2025** extending backward from the lower end of this front frame part **2024**, and that is arranged at the vehicle body widthwise center; and a pivot bracket **2028** that is fixed at the lower end of the back frame part **2021** of the main frame **2022**.

On the pivot bracket **2028**, via a pivot shaft **2029**, there is axially supported the front end part of a swing arm **2030**, and at the rear end part of the swing arm **2030**, there is axially supported the rear wheel **2031**. Between the left and right arms of the swing arm **2030** and a pair of left and right seat frames **2034** that extend backward from the main frame **2022**, there are respectively intervened a pair of left and right rear cushions **2037**. The left and right seat frames **2034** are supported from the lower side, on a pair of left and right rear sub frames **2035** that extend backward and upward from the lower part of the back frame part **2021**. On each seat frame **2034** there is supported a seat **2038** for the driver to sit thereon. In front of the seat **2038** there is provided a tank type cover **2032** so as to cover the upper frame part **2020** of the main frame **2022**.

The back frame part **2021** of the main frame **2022** has, on the upper part thereof, a pair of left and right attachment plates **2042**. Moreover, the front frame part **2024** of the down tube **2026** has a pair of left and right attachment plates **2043** at the vertically intermediate part thereof, and a pair of left and right attachment plates **2044** at the lower part thereof. In addition, the lower frame part **2025** of the down tube **2026** has a pair of left and right attachment plates **2045** at the rear end part thereof.

The power unit assembly **2050** is arranged, in a form of being supported by the respective attachment plates **2042** to **2045** and the pivot bracket **2028**, in a portion that is surrounded by the main frame **2022** and the down tube **2026**.

The power unit assembly **2050** has a substantially rectangular solid-shaped case **2051** that forms the exterior thereof. At the top and bottom of the front surface of a front plate part **2052** of the case **2051** there are respectively formed attachment seat parts **2058** and **2059**, at the top and bottom of the rear surface of a rear plate part **2056** of the case **2051** there are respectively formed attachment seat parts **2060** and **2061**, and at the rear part of the lower surface of a lower plate part **2055** of the case **2051** there is formed an attachment seat part **2062**.

The attachment seat parts **2058** and **2059** are respectively fitted to the attachment plates **2043** and **2044** of the vehicle body frame **2011** by means of bolt fastening or the like, the attachment seat parts **2060** and **2061** are respectively fitted to the attachment plate **2042** of the vehicle body frame **2011** and the pivot bracket **2028** by means of bolt fastening or the like, and the attachment seat part **2062** is fitted to the attachment plate **2045** by means of bolt fastening or the like. As a result, the power unit assembly **2050** is stationarily supported on the vehicle body frame **2011**.

The power unit assembly **2050** becomes a link for a discontinuous part **2065** of the vehicle body frame **2011**, between the pivot bracket **2028** and the lower frame part **2025** which are apart from each other, and this power unit assembly **2050** serves also as part of the vehicle body frame **2011**. That

is to say, the vehicle body frame **2011** has the single main frame **2022**, and is of a monocoque back diamond frame in which the power unit assembly **2050** becomes a link for the discontinuous part **2065** between the pivot bracket **2028** and the down tube **2026** that are fixed on the main frame **2022**.

The case **2051** has the rear end part lower side of the inner space thereof separated by a bulkhead (vertical plate part **2066** and horizontal plate part **2067**), as a housing part for an electric motor **2070**. The side view L-shaped portion of the inner space of the case **2051** along the front plate part **2052** and an upper plate part **2053**, serves as a housing part for the main battery **2091**.

The electric motor **2070** is arranged with the rotation shaft **2080** thereof along the left-right direction, and it rotates a counter shaft **2084** via a reduction gear **2083**. On the left end part of the counter shaft **2084** that projects to the outside of the case **2051**, there is supported a front sprocket **2086**, and a chain **2088** is wound on this front sprocket **2086** and a rear sprocket **2087** on the left side of the rear wheel **2031**, to thereby form a power transmission mechanism. Further, the driving force of the power unit assembly **2050** is transmitted to the rear wheel **2031** via this power transmission mechanism.

The main battery **2091** is formed with three rectangular solid-shaped battery modules **2092**, **2093**, and **2094**. The battery module **2092** is arranged between the lower part of the front plate part **2052** and the vertical plate part **2066** (in front of the electric motor **2070**), the battery module **2093** is arranged above this battery module **2092** and at the rear of the upper part of the upper plate part **2053** (diagonally forward and upward of the electric motor **2070**), and the battery module **2094** is arranged at the rear of this battery module **2093** and between the rear part of the upper plate part **2053** and the horizontal plate part **2067** (above the electric motor **2070**).

Within the case **2051**, there is appropriately formed an air passage for cooling the electric motor **2070** and the main battery **2091**. On the lower surface of the lower plate part **2055** of the case **2051**, there is attached a motor driver (PDU: power driver unit) **2107**, and on the upper surface of the upper plate part **2053** of the case **2051**, there is attached a DC-DC converter **2114**.

Within the tank type cover **2032**, there are arranged a recharger **2121**, a plug cord **2122** for electrically connecting this recharger **2121** to an external power supply such as a commercial power supply, a motor control unit (MCU: motor control unit) **2123**, which is a high voltage electrical component, and a battery managing unit (BMU: battery managing unit) **2124**, which is a high voltage electrical component. Moreover, a 12V sub battery **2127** is arranged within the space surrounded by the back frame part **2021** of the main frame **2022**, the seat frame **2034**, and the rear sub frame **2035**, when seen in side view.

Electric power of the main battery **2091** is supplied to the motor driver **2107** via a contactor that operates in synchronization with a main switch (neither shown in the figure), and it is converted from direct current into three-phase alternating current at the motor driver **2107**, and is then supplied to the electric motor **2070**, which is a three-phase alternating current motor. Moreover, the voltage of the main battery **2091** is lowered via the DC-DC converter **2114**, and it is supplied to the 12V sub battery **2127** and general electrical components such as a lamp, and also to control system components such as the motor control unit **2123**.

The main battery **2091** is recharged by the recharger **2121** connected to an AC100V power supply for example. The recharging/discharging status and the temperature of the main battery **2091** are monitored by the battery managing unit **2124**, and this information is shared with the motor control unit **2123**. The motor control unit **2123** receives inputs of output request information from a throttle (accelerator) sensor, and based on this output request information, the motor control unit **2123** performs control to drive the electric motor **2070** via the motor driver **2107**.

Here, the two wheeled vehicle is provided with a vehicle approach alert device **2040** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **2041** that serves as a sound emitter for emitting an alert sound is arranged in front of the head pipe **2012** and below the head lamp **2018**, and is housed within a lamp case **2018***b* of this head lamp **2018**.

The sound emission direction (sound emission direction, shown with arrow **2041***a* in the figure) of the speaker **2041** is oriented diagonally downward and forward, and sound emission is performed toward the ground from an opening or the like formed at the lower end of the lamp case **2018***b*.

At the rear of the head pipe **2012** and within the front part of the tank type cover **2032**, there is arranged a control unit **2046** for output control of the speaker **2041**. The sound volume of the speaker **2041** is controlled by this control unit **2046** according to the vehicle speed and so forth. By arranging the control unit **2046** and the speaker **2041** in close proximity to each other, installation of wiring between them becomes easy.

Reference symbol **2041'** in the figure denotes a speaker that is arranged in front of the head pipe **2012** and on the front side of the lower part of the meter unit **2019**, and reference symbol **2041***a'* denotes a sound emission direction of the speaker **2041'**. The speaker **2041'** is housed within a meter case **2019***b*. The sound emission direction **2041'** of the speaker **2041'** is oriented diagonally downward and forward, and sound emission is performed toward the ground from an opening or the like formed in the front side of the lower part of the meter case **2019***b*.

As has been described, the vehicle approach alert device **2040** for a saddle-ridden electric vehicle in the above embodiment is such that: the speaker **2041** (or the speaker **2041'**) that is attached on the vehicle body of the two wheeled vehicle **2010** having the electric motor **2070** included in the power engine (power unit assembly **2050**) outputs an alert sound to the surrounding area for notifying the surrounding area of approach of the two wheeled vehicle **2010**; the speaker **2041** (or the speaker **2041'**) is arranged on the inner side of the electric component (the head lamp **2018** or the meter unit **2019**) that is exposed to the exterior of the vehicle; and the sound emission direction of the speaker **2041** (or the speaker **2041'**) is oriented downward.

According to this configuration, by installing the speaker **2041** (or the speaker **2041'**) within the electrical component that is exposed to the exterior of the vehicle, it is possible to efficiently transmit an alert sound to the surrounding area, and protection of the speaker **2041** (or the speaker **2041'**) becomes easy. Moreover, with the sound emission direction of the speaker **2041** (or the speaker **2041'**) being oriented downward, an alert sound can be efficiently transmitted to the surrounding area using ground sound reflection, and it is possible to further reduce the magnitude of the alert sound to be heard by the driver.

Furthermore, the vehicle approach alert device **2040** is such that with the electrical component being arranged in front of the head pipe **2012** of the vehicle body frame **2011**, it

is possible to efficiently transmit an alert sound to the front side of the vehicle and reduce the magnitude of the alert sound to be heard by the driver.

Moreover, in the vehicle approach alert device **2040**, if the electrical component is a head lamp **2018** or a meter unit **2019** that is arranged at the front end of the vehicle body, sound is likely to be transmitted to the front side of the vehicle body, and the magnitude of the sound to be heard by the driver can be reduced. Furthermore, the structure of the speaker **2041** (or the speaker **2041'**) can be simplified using a waterproofing structure or the like for the electrical component.

<Eighth Embodiment>

Next, an eighth embodiment of the present invention is described, with reference to FIG. **14**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A two wheeled vehicle **2201** shown in FIG. **14** that serves as a saddle-ridden electric vehicle is a scooter type vehicle having a low floor **2215** that travels in a manner such that a rear wheel WR axially supported on an axle **2223** is driven to rotate with rotation power exerted by an electric motor M that is built into a swing arm **2221**. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

In the present embodiment, the swing arm **2221** forms, together with the electric motor M, a swing unit **2221**U serving as a power engine of the two wheeled vehicle **2201**.

Below a seat **2224** there is arranged a goods storage box **2249** that can be opened and closed by this seat **2224**, and at the bottom part of this goods storage box **2249** there is arranged a 12V low voltage battery **2255**.

At the front end of a front cover **2207**A there is arranged a front stay **2233** fixed on the head pipe **2236**, and a head lamp (electrical component) **2204** is supported on this front stay **2233**.

Here, the two wheeled vehicle **2201** is provided with a vehicle approach alert device **2250** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **2251** that serves as a sound emitter for emitting an alert sound is arranged in front of the head pipe **2236** and below the head lamp **2204**, and is housed within a lamp case **2204***a* of this head lamp **2204**.

The sound emission direction (sound emission direction, shown with arrow **2251***a* in the figure) of the speaker **2251** is oriented diagonally downward and forward, and sound emission is performed toward the ground from an opening or the like formed at the lower end of the lamp case **2204***a*.

Above the head pipe **2236** and on the inner side of the front cover **2207**A, there is arranged a control unit **2260** for output control of the speaker **2251**. The sound volume of the speaker **2251** is controlled by this control unit **2260** according to the vehicle speed and so forth. By arranging both of the control unit **2260** and the speaker **2251** at the vehicle body front part, installation of wiring between them becomes comparatively easy.

As has been described above, also in the vehicle approach alert device **2250** for a saddle-ridden electric vehicle in the above embodiment, by installing the speaker **2251** within the electrical component (head lamp **2204**) that is exposed to the exterior of the vehicle, it is possible to efficiently transmit an alert sound to the surrounding area and easily protect the speaker **2251**, and also, the structure of the speaker **2251** can be simplified using a waterproofing structure or the like for the electrical component.

Moreover, with the sound emission direction **2251***a* of the speaker **2251** being oriented downward, an alert sound can be efficiently transmitted to the surrounding area using ground sound reflection, and it is possible to further reduce the magnitude of the alert sound to be heard by the driver.

Furthermore, with the electrical component being arranged in front of the head pipe **2236** of the vehicle body frame **2234**, it is possible to efficiently transmit an alert sound to the front side of the vehicle and reduce the magnitude of the alert sound to be heard by the driver.

<Ninth Embodiment>

A ninth embodiment of the present embodiment is described, with reference to FIG. **15**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A two wheeled vehicle **3010** shown in FIG. **15** that serves as a saddle-ridden electric vehicle is such that: at the center part of the vehicle body thereof, there are mounted a main battery **3091** for traveling and a power unit assembly (power engine) **3050**; the power unit assembly **3050** is driven with electric power supplied from the main battery **3091**; and the driving force is transmitted to the a rear wheel **3031**, which is a driving wheel, for traveling. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

In the present embodiment, the rear part of a tank type cover **3032** serves as a knee grip part **3032***a* that is to be sandwiched between both knees of a passenger (driver) sitting on a seat **3038**.

Here, the two wheeled vehicle **3010** is provided with a vehicle approach alert device **3040** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **3041** that serves as a sound emitter for emitting an alert sound is arranged at the rear of a head pipe **3012** and diagonally upward and forward of a power unit assembly **3050**, and also between the front part of an upper frame part **3020** and the upper part of a front frame part **3024** when seen in side view, and it is housed in the lower side of the front end part of the tank type cover **3032**.

The sound emission direction (sound emission direction, shown with arrow **3041***a* in the figure) of the speaker **3041** is oriented diagonally downward and forward, and sound emission is performed toward the ground from an opening part **3041***b* formed in the lower side of the front end part of the tank type cover **3032**.

Within the front end part of the tank type cover **3032** and above the speaker **3041**, there is arranged and housed a control unit (output control device) **3046** for output control of the speaker **3041**. The sound volume of the speaker **3041** is controlled by this control unit **3046** according to the vehicle speed and so forth.

Within the tank type cover **3032** there is arranged and housed a sub battery **3127**, and this sub battery **3127** supplies electric power to the speaker **3041** and the control unit **3046**.

With the speaker **3041**, the control unit **3046**, the sub battery **3127**, and the motor control unit **3123** being collectively arranged within the tank type cover **3032**, installation of wiring between the respective devices becomes easy.

As has been described above, the vehicle approach alert device **3040** for a saddle-ridden electric vehicle in the above embodiment, is such that the speaker **3041** that is attached on the vehicle body of the two wheeled vehicle **3010** having the electric motor **3070** included in the power engine (power unit assembly **3050**) outputs an alert sound to the surrounding area for notifying the surrounding area of approach of the two

wheeled vehicle **3010**. At the rear of the head pipe **3012** of the vehicle body **3011**, the two wheeled vehicle **3010** is provided with an exterior member (tank type cover **3032**) that has the knee grip part **3032***a* to be sandwiched by both knees of the driver, and the speaker **3041** is arranged within the exterior member while the sound emission direction **3041***a* thereof is oriented diagonally downward and forward.

According to this configuration, with the speaker **3041** being arranged within the exterior member, which is comparatively large, it is possible to make use of the hollow within the exterior member to thereby achieve superior sound transmission to the surrounding area, and suppress sound transmission to the upper side (driver side) of the exterior member to thereby reduce the magnitude of sound to be heard by the driver. Moreover, with the speaker **3041** emitting sound diagonally downward and forward, it is possible to transmit sound efficiently to the surrounding area, using ground sound reflection. Furthermore, it is possible, with the exterior member, to protect the speaker **3041** easily.

Moreover, the vehicle approach alert device **3040** is such that with the exterior member having the opening part **3041***b* toward the sound emission direction **3041***a* of the speaker **3041**, the sound of the speaker **3041** can be easily emitted to the outside of the cover (diagonally downward and forward), and sound can be transmitted efficiently to the surrounding area using ground sound reflection, while reducing the magnitude of an alert sound to be heard by the driver.

Furthermore, the vehicle approach alert device **3040** is such that with the speaker **3041** being arranged within the front end part of the exterior member, it is possible to have the speaker **3041** distanced from the driver, and the magnitude of the alert sound to be heard by the driver can be reduced.

Moreover, the vehicle approach alert device **3040** is such that with the driving control device (motor control unit **3123**) for the power engine and the output control device (control unit **3046**) for the speaker **3041** being arranged within the exterior member, the speaker **3041**, the control unit **3046**, and the motor control unit **3123** are arranged in close proximity to each other. As a result, installation of wiring between them can be done easily and the respective control devices can be easily protected.

Furthermore, the vehicle approach alert device **3040** is such that with the sub battery **3127** that serves as a power supply of the speaker **3041** being arranged within the exterior member, the speaker **3041** and the sub battery **3127** serving as the power supply thereof are arranged in close proximity to each other. As a result, installation of wiring between them can be done easily.

<Tenth Embodiment>

Next, a tenth embodiment of the present invention is described, with reference to FIG. **16**. Descriptions of constituents the same as or similar to those in the above embodiments are appropriately simplified or omitted.

A two wheeled vehicle **3210** shown in FIG. **16** that serves as a saddle-ridden electric vehicle is such that: below a main frame **3220** of a vehicle body frame **3211** there is arranged a power unit (power engine) **3234** having an electric motor **3233** for generating traveling driving force provided therein; on the upper side and on both left and right sides of the main frame **3220** there is arranged a battery unit **3236** having a battery **3235** for supplying electric power to the electric motor **3233** provided therein; and the driving force of the electric motor **3233** is transmitted to a rear wheel **3225**, which is a driving wheel, for traveling. Arrow FR in the figure denotes the front side of the vehicle and the arrow UP denotes the upper side of the vehicle.

Into a head pipe **3212** at the front end of the vehicle body frame **3211** there is rotatably inserted a steering stem **3214**. At the lower end of the steering stem **3214** there is fixed a bottom bridge **3214***a*, and at the upper end there is fixed a top bridge **3214***b*. On both of the left and right sides of the respective bridges **3214***a* and **3214***b* there are attached the upper part of a front fork **3215** with a pair of left and right portions. On the lower end part of the left and right portions of the front fork **3215** there is axially supported a front wheel **3216**. At the upper part of the top bridge **3214***b* there is attached a steering handle bar **3217**. In front of the head pipe **3212** there is arranged a single-lamp type circular head lamp **3218**.

At the lower rear end of the main frame **3220** that extends diagonally backward and downward from the head pipe **3212**, there is fixed a pivot bracket **3221**, and on this pivot bracket **3221** there is vertically swingably supported the front end part of the swing arm **3224** via a pivot shaft **3223**. At the rear end part of the swing arm **3224** there is axially supported a rear wheel **3225**. Between the left and right arms of the swing arm **3224** and a pair of left and right seat frames **3227** that extend backward from the main frame **3220**, there are respectively intervened a pair of left and right rear cushions **3229**. The left and right seat frames **3227** are supported, from the lower side, on a pair of left and right rear sub frames **3228** that extend backward and upward from the upper part of the pivot bracket **3221**. On each seat frame **3227** there is supported a seat **3230** for the driver to sit thereon. In front of the seat **3230** there is provided a tank type cover (exterior member) **3283** that covers, from above, the battery **3235** and so forth in the battery unit **3236**.

The power unit **3234** houses the electric motor **3233** having the rotation shaft thereof along the left-right direction, within a case **3263** that forms the exterior thereof. The rotation power of the electric motor **3233** is transmitted to a driving shaft **3264** via a transmission mechanism (not shown in the figure), within the case **3263**. The driving shaft **3264** projects to the left side of the case **3263**, and a front sprocket **3265** is supported on this projecting portion. A chain **3267** is wound on this front sprocket **3265** and a rear sprocket **3266** on the left side of the rear wheel **3225**, to thereby enable transmission of the driving force of the power unit **3234** to the rear wheel **3225**.

The top and bottom of the rear part of the case **3263** are respectively fitted to the top and bottom of the pivot bracket **3221** by means of bolt fastening or the like. On the upper side of the front part of the case **3263** there is provided a narrow width part **3271** that extends upward, and the upper end part of this narrow width part **3271** is fitted by means of bolt fastening or the like to an attachment plate **3240** that projects to the lower side of the front part of the main frame **3220**. As a result, the power unit **3234** is stationarily supported on the vehicle body frame **3211**.

At the upper part of the case **3263** there is formed a connection opening **3279** for introducing air for cooling devices into the case **3263**. At the lower part of the case **3263** there is formed an air exhaust opening (not shown in the figure), for discharging the air.

The battery unit **3236** has a tank type cover **3283** that forms the exterior thereof. The tank type cover **3283** is provided so as to straddle over (so as to cover from above) the main frame **3220** and the narrow part **3271** of the power unit **3234**.

Within side part storage parts **3285** on both the left and right side of the tank type cover **3283**, there is respectively stored a battery **3235**. In an upper storage part **3284** of the tank type cover **3283** there are stored an electrical transformer (DC-DC converter) **3286**, which is a high voltage electrical component other than the battery **3235**, and a motor driver

(driving control device) (PDU: power driver unit) **3287**. The rear part of a tank type cover **3283** serves as a knee grip part **3283***a* that is to be sandwiched between both knees of a passenger (driver) sitting on the seat **3230**.

The battery **3235** comprises, for example, a plurality of electrical batteries, and it is provided in an L shape in which the lower part rear side thereof is concaved when seen in side view. In the concaved portion on the lower part rear side of the battery **3235**, which is the side storage part **3285** on the left side of the battery unit **3236**, there is arranged a motor control unit (MCU: motor control unit) **3289** that controls the electric motor **3233** to drive. In the concaved portion similarly on the lower part rear side of the battery **3235**, which is the side storage part **3285** on the right side of the battery unit **3236**, there is arranged a battery managing unit (BMU: battery managing unit) **3290** that monitors the battery **3235**.

The front lower end part of the tank type cover **3283** is fitted to the base end side of the narrow width part **3271** of the power unit **3234**, and the rear lower end part of the tank type cover **3283** is fitted to an attachment plate **3241** projecting to the rear part upper side of the main frame **3220**, respectively by means of bolt fastening or the like. As a result, the battery unit **3236** is stationarily supported on the vehicle body frame **3211** and the power unit **3234**.

The tank type cover **3283** has a case main body **3296** and a cover **3298** that covers an upper opening **3297** of the case main body **3296**. At the front end of the cover **3298** there is formed an opening part **3300** that opens forward, and air can be introduced from the outside into the tank type cover **3283** via this opening part **3300** and the upper opening **3297**.

At the lower part of each of the left and right side storage parts **3285** of the case main body **3296** there is provided an air exhaust opening **3301** for discharging the air that has been introduced into the battery unit **3236**.

The left and right air exhaust openings **3301** are of an accordion shape that can be extended and/or retracted and deformed, and they are respectively connected to the left and right connection openings **3279** of the power unit **3234**.

The power unit **3234** and the battery unit **3236** are electrically connected via a connection harness **3237** routed within the main frame **3220** for example.

Electric power of the battery **3235** is supplied to the motor driver **3287** via a contactor that operates in synchronization with a main switch (neither shown in the figure and it is converted from direct current into three-phase alternating current at the motor driver **3287**, and is then supplied to the electric motor **3233**, which is a three-phase alternating current motor. Moreover, the voltage of the battery **3235** is lowered via the electrical transformer **3286**, and it is supplied to the 12V sub battery **3291** and general electrical components such as a lamp, and also to control system components such as the motor control unit **3289**.

The battery **3235** is recharged by a recharger (not shown in the figure), connected to an AC100V power supply for example. The recharging/discharging status and the temperature of the battery **3235** are monitored by the battery managing unit **3290**, and this information is shared with the motor control unit **3289**. The motor control unit **3289** receives inputs of output request information from a throttle (accelerator) sensor (not shown in the figure), and based on this output request information, the motor control unit **3289** performs control to drive the electric motor **3233** via the motor driver **3287**.

Here, the two wheeled vehicle is provided with a vehicle approach alert device **3250** that notifies pedestrians or other road users of approach of the vehicle, by outputting a predetermined alert sound from a sound emitter installed on the vehicle.

In the present embodiment, a speaker **3251** that serves as .a sound emitter for emitting an alert sound is arranged at the rear of a head pipe **3212** and diagonally upward and forward of the power unit **3234**, and below the front end of the main frame **3220** when seen in side view, and it is housed in the front end part of the tank type cover **3283**.

The sound emission direction (sound emission direction, shown with arrow **3251***a* in the figure) of the speaker **3251** is oriented diagonally downward and forward, and sound emission is performed toward the ground from an opening part **3251***b* formed in the front end part of the tank type cover **3283**.

Within the front end part of the tank type cover **3283** and above the speaker **3251**, there is arranged and housed a control unit (output control device) **3252** for output control of the speaker **3251**. The sound volume of the speaker **3251** is controlled by this control unit **3252** according to the vehicle speed and so forth. By arranging the control unit **3252** and the speaker **3251** in close proximity to each other, installation of wiring between them becomes easy.

Within the tank type cover **3283**, there is arranged and housed a sub battery **3291**, and this sub battery **3291** supplies electric power to the speaker **3251** and the control unit **3252**.

With the speaker **3251**, the control unit **3252**, the sub battery **3291**, and the motor control unit **3289** being collectively arranged within the tank type cover **3283**, installation of wiring between the respective devices becomes easy.

As has been described above, also in the vehicle approach alert device **3250** for a saddle-ridden electric vehicle in the above embodiment, with the speaker **3251** being arranged within the exterior member (tank type cover **3283**), which is comparatively large, it is possible to make use of the hollow within the exterior member to thereby achieve superior sound transmission to the surrounding area, and suppress sound transmission to the upper side (driver side) of the exterior member to thereby reduce the magnitude of sound to be heard by the driver. Moreover, with the speaker **3251** emitting sound diagonally downward and forward, it is possible to transmit sound efficiently to the surrounding area, using ground sound reflection. Furthermore, it is possible, with the exterior member, to protect the speaker **3251** easily.

Moreover, with the opening part **3251***b* provided in the exterior member, sound of the speaker **3251** can be easily emitted to the outside of the cover (diagonally downward and forward), and sound can be transmitted efficiently to the surrounding area using ground sound reflection, while reducing the magnitude of an alert sound to be heard by the driver.

Furthermore, with the speaker **3251** being arranged within the front end part of the exterior member, it is possible to have the speaker **3251** distanced from the driver, and the magnitude of the alert sound to be heard by the driver can be reduced.

In addition, by arranging the speaker **3251**, the sub battery **3291**, the control unit **3252**, and the motor control unit **3289** in close proximity to each other, installation of wiring between them can be easily done, and the respective control devices can be protected easily.

The present invention is not limited to the respective embodiments above, and for example in addition to an electric two wheeled vehicle and an electric three wheeled vehicle described above, the invention may also be applied to a three wheeled vehicle with two front wheels and one rear wheel, or to a four wheeled vehicle, as long as the vehicle is an electric vehicle on which a driver straddles over the vehicle body to

ride the vehicle. Moreover, the configurations of the respective embodiments above may also be appropriately combined or switched.

The configurations of the respective embodiments above are an example of the present invention, and various types of modifications may be made thereto without departing from the scope of the invention.

INDUSTRIAL APPLICABILITY

According to the present invention, it is possible to provide a vehicle approach alert device for a saddle-ridden electric vehicle in which the arrangement of a sound emitter for outputting an alert sound for notifying the surroundings of approach of a vehicle is optimized.

DESCRIPTION OF REFERENCE SYMBOLS

10, **101**, **201** Two wheeled vehicle (saddle-ridden electric vehicle)
301 Three wheeled vehicle (saddle-ridden electric vehicle)
41, M, **332** Electric motor (power engine)
103 Motor unit (electric motor, power engine)
40, **140**, **250**, **340** Vehicle approach alert device for saddle-ridden electric vehicle
48, **48'**, **160**, **160'**, **251**, **341** Speaker (sound emitter)
48*a*, **48***a'*, **160***a*, **160***a'*, **251***a*, **341***a* Sound emission direction
49, **251***c*, **342** Sound emission duct
11, **111**, **234**, **305** Vehicle body frame
12, **112**, **236**, **312** Head pipe
43A, **121**A, **207**A, **324**A Front cover
16*a*, **105***a*, **307***a* Front fender
21 Lower down frame (vehicle body frame member)
305*f* Front part frame (vehicle body frame member)
15, **106**, **313** Front fork
105 Front wheel
1201 Two wheeled vehicle (saddle-ridden electric vehicle)
1301 Three wheeled vehicle (saddle-ridden electric vehicle)
1240, **1340** Vehicle approach alert device for saddle-ridden electric vehicle
1241, **1341** Speaker (sound emitter)
1241*a*, **1341***a* Sound emission direction
1218U Swing unit (power engine, driving unit)
1218*a* Unit cover
1309 Power unit (power engine, driving unit)
1358*a* Extended cover (unit cover)
1208, **1332** Electric motor
1207, **1308** Rear wheel (driving wheel)
1211, **1305** Vehicle body frame
1317 Swing joint (swing mechanism)
1351 Battery
2010, **2201** Two wheeled vehicle (saddle-ridden electric vehicle)
2011, **2234** Vehicle body frame
2012, **2236** Head pipe
2018, **2204** Head lamp (electrical component)
2019 Meter unit (electrical component)
2040, **2250** Vehicle approach alert device for saddle-ridden electric vehicle
2041, **2251** Speaker (sound emitter)
2041*a*, **2251***a* Sound emission direction
2050 Power unit assembly (power engine)
2070, M Electric motor
2221U Swing unit (power engine)
3010, **3210** Two wheeled vehicle (saddle-ridden electric vehicle)
3011, **3211** Vehicle body frame
3012, **3212** Head pipe
3032, **3283** Tank type cover (exterior member)
3032*a*, **3283***a* Knee grip part
3040, **3250** Vehicle approach alert device for saddle-ridden electric vehicle
3041, **3251** Speaker (sound emitter)
3041*a*, **3251***a* Sound emission direction
3046, **3252** Control unit (output control device)
3050 Power unit assembly (power engine)
3070, **3233** Electric motor
3107, **3287** Motor driver (driving control device)
3127, **3291** Sub battery (battery)
3234 Power unit (power engine)

The invention claimed is:

1. A vehicle approach alert device for a saddle-ridden electric vehicle that is attached to a vehicle body of the saddle-ridden electric vehicle having an electric motor included in a power engine, and that is provided with a sound emitter that emits an alert sound to a surrounding area for notifying the surrounding area of an approach of the saddle-ridden electric vehicle, wherein:

the alert sound of the sound emitter is controlled according to a traveling status of the saddle-ridden electric vehicle;

the sound emitter is arranged so that a direction of the alert sound is oriented diagonally downward and forward of the saddle-ridden electric vehicle,

the sound emitter raises a frequency of the alert sound with an increase in a rotation speed of the electric motor,

an increase rate of this alert sound frequency is set so as to be lower than an increase rate of the rotation speed of the electric motor, and

the alert sound is set to be in a range between 100 Hz and 800 Hz and includes:

a first sound having a frequency and serving as a reference sound,

a second sound having a frequency higher than the frequency of the first sound,

a third sound having a frequency higher than the frequency of the second sound, and

a difference of 1 subtracted from a ratio of the frequency of the second sound with respect to the frequency of the first sound is set to be greater than a difference of a ratio of the frequency of the second sound with respect to the frequency of the first sound subtracted from a ratio of the frequency of the third sound with respect to the frequency of the first sound.

2. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim **1**, wherein:

the saddle-ridden electric vehicle is provided with a front cover that covers a periphery of a head pipe of a vehicle body frame; and

the sound emitter is arranged on an inner side of the front cover.

3. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim **2**, wherein:

the saddle-ridden electric vehicle is further provided with a sound emission duct that extends diagonally downward and forward from the sound emitter along the alert sound direction; and

the sound emitter is attached to the vehicle body frame, on the inner side of the front cover, and emits the alert sound to an outer side of the front cover through the sound emission duct.

4. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim **2**, wherein the sound emitter is arranged below the head pipe.

5. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 4, wherein the sound emitter is arranged on an outer side of a front fender of the saddle-ridden electric vehicle.

6. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 2, wherein:

the saddle-ridden electric vehicle is further provided with a vehicle body frame member that extends diagonally backward and downward of this saddle-ridden electric vehicle, from the head pipe;

on the head pipe there is steerably supported a front fork that extends diagonally forward and downward and that suspends a front wheel; and

the sound emitter is arranged in front of the vehicle body frame member and at the rear of the front fork when this saddle-ridden electric vehicle is seen from a side.

7. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 2, wherein:

on the head pipe, there is steerably supported a front fork that extends diagonally forward and downward and that suspends a front wheel; and

the sound emitter is arranged in front of the front fork when this saddle-ridden electric vehicle is seen from a side.

8. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 1, wherein:

the saddle-ridden electric vehicle is further provided with a driving unit that supports the electric motor and a driving wheel, and that is connected to the vehicle body frame so as to be able to swing vertically with respect to the vehicle body frame; and

the sound emitter is provided on the driving unit and also at a position below a driver's seat part.

9. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 8, wherein:

the saddle-ridden electric vehicle is further provided with a unit cover that covers the driving unit; and

within the unit cover, there is arranged the sound emitter.

10. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 8, wherein:

the saddle-ridden electric vehicle is a swing type vehicle such that the vehicle body frame swings left and right with respect to the driving unit having a pair of the driving wheels; and

the sound emitter is arranged above a swing mechanism that connects the driving unit and the vehicle body frame.

11. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 8, wherein:

the saddle-ridden electric vehicle is further provided with a battery between the pair of driving wheels; and

the sound emitter is arranged in front of the battery.

12. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 1, wherein the sound emitter is arranged on an inner side of an electrical component that is exposed to an outside of the saddle-ridden electric vehicle.

13. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 12, wherein the electrical component is arranged in front of a head pipe of the vehicle body frame.

14. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 12, wherein the electrical component is a head lamp that is arranged at a front end of the vehicle body.

15. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 12, wherein the electrical component is a meter unit that is arranged at a front end of the vehicle body.

16. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 1, wherein:

the saddle-ridden electric vehicle is further provided, at the rear of a head pipe of a vehicle body frame, with an exterior member having a knee grip part that is to be sandwiched between both knees of the driver; and

the sound emitter is arranged on an inner side of the exterior member.

17. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 16, wherein the exterior member has an opening part that opens toward the direction of the alert sound.

18. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 16, wherein the sound emitter is arranged within a front end part of the exterior member.

19. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 16, wherein a driving control device for the power engine and an output control device for the sound emitter are arranged within the exterior member.

20. The vehicle approach alert device for a saddle-ridden electric vehicle according to claim 16, wherein a battery that serves as a power supply for the sound emitter is arranged within the exterior member.

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